NATIONAL MUSEUM OF VICTORIA

The Journal of the Department of Agriculture

VICTORIA — AUSTRALIA

VOLUME XXXIII

PART 4

PRICE 3D.

Registered at the General Post Office Melbourne for transmission by Post as a Newspaper

APRIL, 1935

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Issued under the direction of the Hon. E. J. Hogan, M.L.A., Minister of Agriculture.

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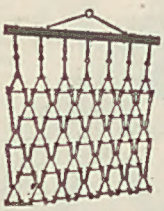

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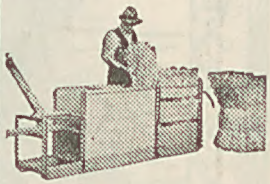

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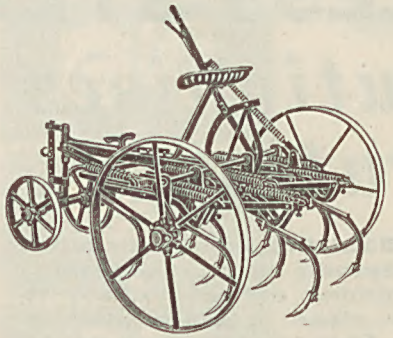

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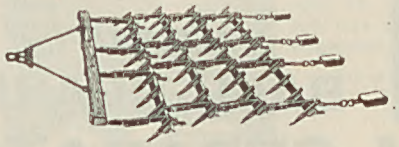

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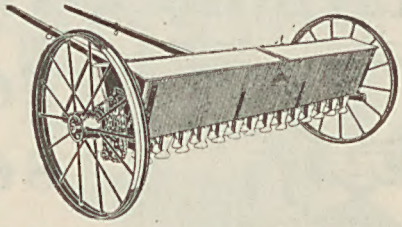

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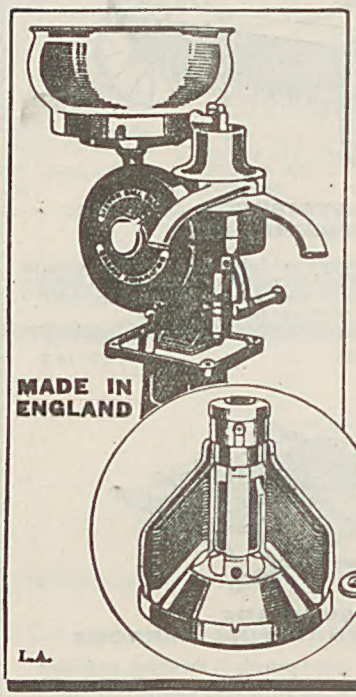

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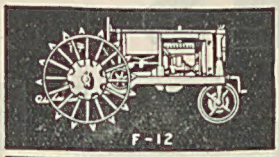

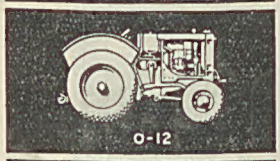

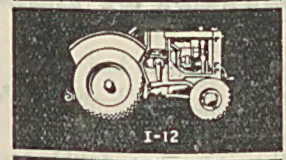

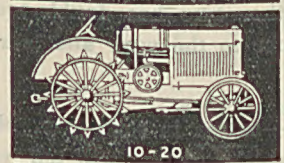

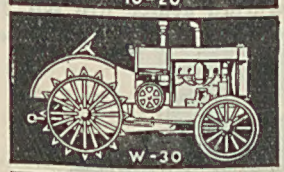

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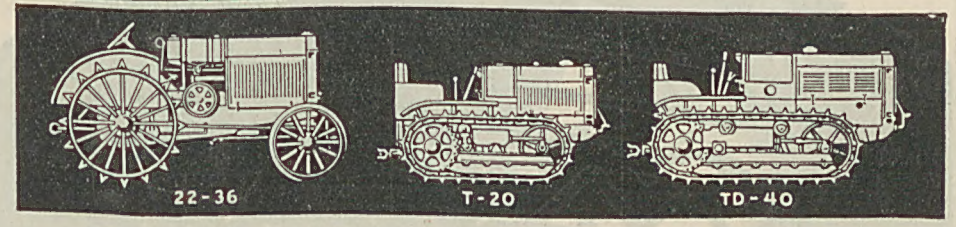

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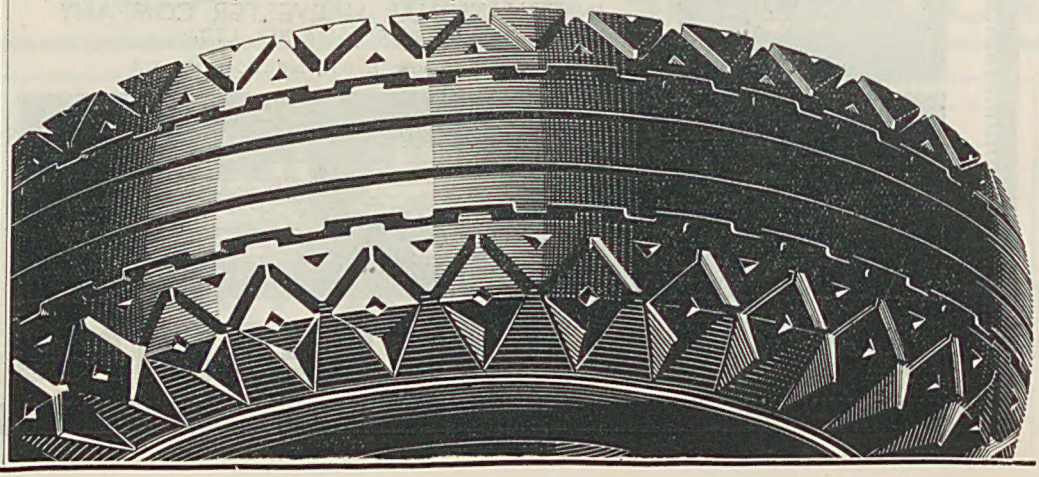

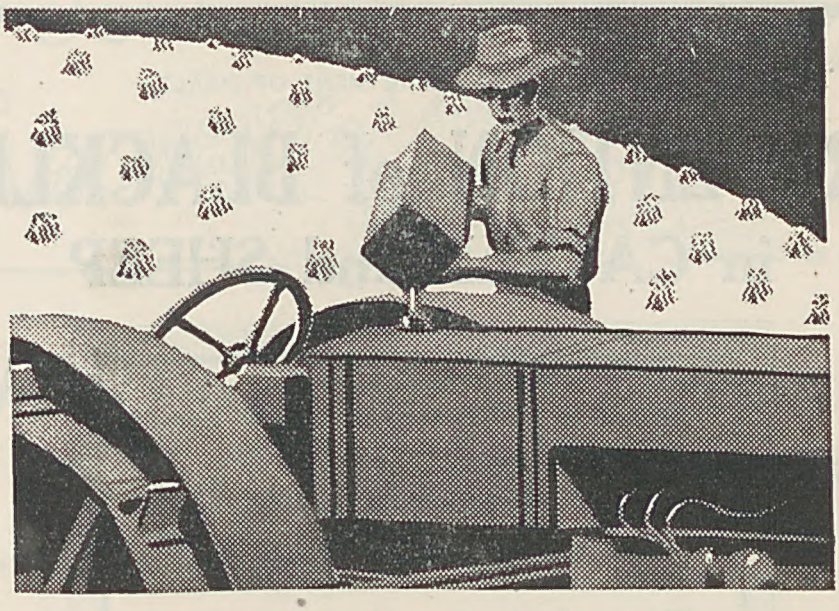

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The Journal of the DEPARTMENT of AGRICULTURE of VICTORIA

The Department of Agriculture

Some Recent Activities

An address by H. A. Mullett, B.Agr.Sc., Director of Agriculture, at the 33rd Annual Convention of the Chamber of Agriculture, at Port Fairy, March, 1935.

THE individual farm is a self-contained unit on which the problems of organization are relatively simple, and a study of them may induce the thought that, as an industry, agriculture has no problems in organization that parallel those in a production unit of a modern industrial plant. But in any consideration of problems of organization the agriculture of the State should be regarded as a single industry; then it will be seen to consist in Victoria of some 75,392 small but widely-scattered production units dotted over an area of 56 million acres. Not only are the units of production scattered, but each has a different manager, and the produce is wrung from the soil by means of the most complex of machinery—the plant and the animal. It is fabricated in the open air under variable conditions of rain, heat, and cold, and it is subject to the ravages of the manifold enemies of plants and animals; much of it is perishable, and has to be marketed—in so far as exports are concerned—at least 12,000 miles from the point of production. By comparison, the co-ordination of the processes of manufacture is simple, for here the units of production generally are relatively concentrated, as in factories, and often the only variable factor of any importance is the market price, though sometimes even that is constant.

The upsetting factor of climate and the susceptibility to disease of the agricultural production of a country are apt to be underrated. Imagine, for example, the effect upon the Broken Hill Proprietary Steel Company's works at Newcastle if a considerable portion of the year's output were destroyed by rust and the balance so affected in appearance that it was saleable only at a discount! Yet another kind of rust—*Puccinia graminis*—is liable to do just that kind of damage to a farmer's wheat crop, and, in fact, did so in this State last year. There are innumerable diseases that may attack the plant and the animal, and some of them are still beyond human control.

Viewed as a whole, agriculture is the greatest single industry in this State, producing from £30,000,000 to £50,000,000 worth of new wealth annually, and furnishing 90 per cent. of the total value of all exportable goods; and I submit that, from the point of view of a problem in organization, there is no industry more complex.

Before the coal and iron era in Britain, all industry consisted of small, scattered, self-contained, independent units; but, so far as secondary industries were concerned, the machine age changed that and evolved the modern mass production factory, where the units of production are essentialy concentrated, and where the rate of production, its quality, quantity, cost, and the labours of a multitude of men and machines are rigidly controlled.

In the popular view, machinery is the all-important factor in industrial advancement; but, equally important is the special organiza-

tion that has been gradually evolved to control the production of the many men engaged in the factory so that the technical problems of manufacture are met as they arise, so that the production is uninterrupted, so that waste is eliminated, the processes co-ordinated, the quality of the product standardized, and, above all, so that costs are on a competitive basis.

Agriculture, to a far greater extent than secondary industry, has retained the primitive system of small, scattered units in production. It can scarcely be otherwise, though the Russians are applying the large-scale production unit methods to agriculture. In every country it has been found necessary to create and maintain an organization which is a close parallel of the higher control of the factory. That organization is known as the Department of Agriculture. Its job is essentially that of co-ordinating the activities of each of the small units of production and providing, *for the general good of the industry,* the technical services that the small components themselves cannot afford and, in fact, seldom realize are necessary.

Each Department of Agriculture has three main activities, but in addition it may be called upon, as is the case in Victoria, to run business enterprises in the interests either of an industry as a whole or of a section of it. The three functions are—

(*a*) Regulatory;
(*b*) research and investigation; and
(*c*) advisory and extension.

Regulatory functions are those which may be defined as dealing with the enforcement of individual action for the common good of the industry—for example, the maintenance of quality standards and the prevention of animal diseases. Practically all regulatory functions are necessarily irksome to the individual, because human nature is such that few individuals will take drastic action at cost or trouble to themselves for the common good, and hence, in respect of these functions, it is necessary to have statutory powers enforceable in law.

In essence, the functions of *research and investigation* are the ascertaining of the facts of production with a view to increasing production, raising quality, reducing costs, and preventing the destruction of produce by disease.

The *advisory and extension* functions are concerned with the distribution of the technical facts ascertained as the result of research and investigation. A few random examples will suffice to illustrate each of these activities:—

Regulatory Functions.

The regulatory functions go further than regulating the units of production, that is to say, the farms; they go as far as regulating the secondary industries which supply the necessities of the farm; indeed, recent legislation has attempted to fix the price that the farmer shall be paid for his produce, as is the case with the Milk Board Act, and machinery has even been set up in the case of the butter industry to ensure that butter sells at a higher price in Victoria than in London.

The following is a characteristic example of *regulation of the producer,* having for its object the production of uniform standards of quality:—Left to themselves, orchardists have varying ideas as to the way apples should be marketed for export. Theoretically, there could be as many types of pack as there are orchardists, some, no doubt, having great merit and others having no merit. Again, some would be tempted to use second-hand cases, the shapes

Portion of the Government Cool Stores—one of the business enterprises run by the Department of Agriculture.

of the packages would vary, and in some instances the fruit would be packed unsystematically, and in others with great regularity. Sizes would vary, and in consequence the buyer would not know the outturn of a case until it was open. The maturity of the fruit would vary, and in some cases be green, others too ripe; in fact, it is obvious that the get-up would be anything but uniform. The Department of Agriculture (as agent for the Commonwealth) prescribes standards of quality for the fruit packed; specifications for the type of case are laid down; the methods of packing and the sizes comprising the various grades, &c,, and even the colour at which the fruit may be marketed, are prescribed, and these are gazetted as regulations under the Commerce Act, and then have the force of law.

Inspectors see that the standards are maintained, and unsatisfactory consignments are rejected from time to time. Formerly rejections at the ship's side were frequent and disconcerting to the producers concerned. Now inspectors do the bulk of their work in the country districts at the packing-sheds, and cause any necessary alterations to be made without much inconvenience to the trade.

The Fertilizers Act provides an instance where a phase of secondary industry is regulated for the benefit of the producer. Although producers may have practical experience of fertilizers, few really understand the mystery of their composition and how to evaluate them. Were there no law governing their sale, they would prove a gold-mine to unscrupulous traders, who could readily adulterate the fertilizer and otherwise misrepresent its value. But the law requires that each bag shall bear a label setting out the analysis and guaranteeing the contents of the bag to be as set out on the label.

Inspectors check the contents from time to time, the samples are analysed in the State chemical laboratory, and prosecutions follow adulteration or misrepresentation. In addition, every brand of fertilizer must be registered with the Department, together with the analysis and the price to be charged. The Department has power to refuse registration, and, in fact, has done so in cases where claims for special virtues cannot be substantiated. In addition, a table is published annually in the Department's *Journal*, from which any one can readily calculate whether the price asked for any particular fertilizer is reasonable.

For many years the sale of lime was subject to no such regulation; but the increasing number of brands on the market, their widely-varying lime content, and the difficulty the farmer had in discriminating between them brought about the passing of the *Agricultural Lime Act* 1934, under which lime is required to comply with provisions similar to those of the Fertilizers Act. The above are some examples of the normal type of regulatory functions of the Department.

Faced with a surplus of production and falling prices, factories tend to reduce output by closing down a section of their works, but, in the case of agriculture, concerted action is much more difficult, largely beause the units of production are not subject to the will of a co-ordinating authority as they are in factories, but are free and independent, at all events under existing law. In times of surplus production and falling prices, instead of the tendency to restrict production, as in the factory, there is a marked tendency to increase it in order that the same cash return shall be obtained as when prices were higher. The world has not yet come to the stage of compulsory restriction of production in agriculture, and glutted markets have resulted in low prices. Consequently, during the economic crisis, it became necessary for the Government to enact emergency measures, largely experimental in character, having for their objective the sustaining of prices within Australia.

Inspectors taking samples of artificial fertilizers.

In the butter industry there was an increasing tendency on the part of dairy companies to sell the whole of their products on the local market, where a higher price was being maintained by the Paterson plan, and an increasing difficulty in getting them to share in the loss on export. The majority of those engaged in the dairying industry throughout Australia became convinced that the stabilization plan was in danger of collapse, and needed to be shored up by legislative authority.

The problem of devising effective legislation was an intricate legal one, because it involved the control of consumption within the State, the control of the export trade, and the control of interstate trade. Concerted action by the States concerned and by the Commonwealth was necessary, and legislative machinery was successfully devised for this purpose. The principle pioneered in the *Dried Fruits Act* 1928 was incorporated in the legislation, and the Act works as follows:—

The State fixes the percentage of butter which may be sold within the State within a given period. The Commonwealth fixes the percentage of butter which may be exported within the same period. Interstate trade is by licence, subject to the observance of the conditions of export. Authority to administer the Act was delegated to the Dairy Products Board, which concerns itself with advising the Minister as to the quota to be observed for the time being, and in policing the various machinery provisions of the Act. It is not the business of either the Commonwealth or State Boards to fix prices, but to bare the market of surplus butter by the compulsory export of the surplus. When this has been done, and the amount of butter likely to be on hand is not in excess of local requirements plus a reasonable carry-over, the trade, acting under a legal agreement as a company, fixes the price at an agreed limit above the export parity.

Despite the fact that penalties of up to £500 were provided in the Act for failure to observe the quota provisions, some factories have sold all their butter on the local market, and have refused to share in the loss on export. This proved to be a profitable business, because the fines so far imposed have been much less than the equalization payment. This is a matter that, no doubt, will be corrected by amending legislation.

The above is one of the most complicated of the regulatory functions that has, so far, been attempted in agriculture in Australia. If another example is needed of the extent to which the regulation of the industry has proceeded, it is to be found in the *Milk Board Act* 1934. Here the central feature is to ensure an economic return to a section of producers engaged in a phase of production which, in the interests of public health, it is desirable should be sufficiently remunerative to enable it to be conducted under the most hygienic standards of production. As a much greater quantity of milk is produced than is required for consumption as whole milk, it was necessary to devise legal and administrative machinery to separate the two classes. Parliament would not agree to any geographic boundary being drawn, and hence the separation of the two was left to ordinary business negotiations between the buyer and the producers. Such transactions were required to be under contract approved by the Board. The Board is empowered, if necessary, to eliminate wasteful competition in the metropolis by closing up redundant distributing businesses, subject to the payment of compensation.

Seeing that at the present time the producer of whole milk receives approximately 2d. per gallon more than those who sell it for butter manufacture, there is obviously great pressure to break down the provisions of the Act in respect to price fixing.

This legislation, together with that in New South Wales, is a pioneering attempt to fix prices within an industry in the interest of a section of the industry. No form of price fixing could place greater strain upon human nature, and the Board has been set a most difficult problem to police the Act.

The licensing of dairies and the maintenance of satisfactory hygienic standards upon dairy farms and in retail dairies, &c., are functions of the Department of Agriculture. As the Milk Board raises the economic status of the industry, the Department will be entitled to call upon the various component parts to improve the conditions under which whole milk is produced, distributed, and sold.

The purity of the milk supplied the metropolis is reasonably high compared with standards in other parts of the world, but a number of improvements remains to be effected, including the grading and bottling of milk. As the industry is about to be re-organized economically, and certain persons eliminated, it would be unwise to enforce these provisions until such elimination has been carried into effect,

otherwise, many persons would be forced to undertake heavy expenditure only to find, a little later, that the premises were delicensed on economic grounds.

Early this year the Department began a reorganization of the administrative machinery used for the regulation of the dairying industry. In recent years, the quality of Victorian butter has steadily declined. In my view, in the initial stages, this was due to the fact that factory managers had for years been leaning upon the preservative, boric acid, as a crutch, as by its use they had been able to arrest those natural processes of deterioration which generally follow slovenly manufacture and careless production on the farm. Its sudden compulsory cessation found everybody unprepared, and the quality fell down. Following are the latest figures for the proportions of export butter graded choicest in the various States:—

	Per cent.
New South Wales	90
Victoria	44
Queensland	43
Tasmania	38
Western Australia ..	6
South Australia	1

Quality in butter is largely a matter of the strict observance, both on the farm and in the factory, of a well-established technique designed to prevent the introduction into the cream of unfavorable bacteria, and of flavours produced by them. Other factors do count, of course, but the more insidious and the more usual is bacterial contamination. The expert instruction of factory managers and of factory suppliers is essential, and compulsion of the recalcitrant unfortunately has been found necessary, simple though the hygienic precautions are.

Though the whole of the State is not under Government dairy supervision, a very considerable portion is, and some 67 dairy supervisors and 6 factory inspectors were allotted to the industry. Until recently, however, this force was not being employed in the most efficient way. The factory inspectors worked largely independently of the dairy supervisors; the latter, having dual duties as stock inspectors, following the advent of the Cattle Compensation Act, became largely absorbed in the control of live-stock diseases and in assessing claims for compensation.

In the re-organization a Superintendent of Dairying was appointed, to whom all dairy produce inspectors and 47 dairy supervisors—who are relieved of all duty of live-stock inspection—were made responsible. Special attention is being given to quality improvement, the dairy produce inspectors co-operating closely with the dairy supervisors in tracking to their source, whether factory or farm, faults detected in the butter as marketed. Thus, the visit of a dairy produce inspector to a factory arises directly from low quality in the marketed product of that factory, and the visit of the dairy supervisor arises directly from proof at the factory that the farmer has contributed to the manufacture of the inferior product by failure to supply choicest cream. The new system has been in operation since the 1st of January of this year, and it cannot but have had an important influence for the better upon the quality of Victorian butter.

The live stock division also has been reorganized by the assignment of thirteen dairy supervisors for full-time duty as stock inspectors, the total strength of staff engaged upon stock inspection having been brought up to 29. With this additional stock inspection staff the size of the districts has been reduced, and, generally, it is believed that by confining the stock inspection to the stock inspection staff much more effective work will be done.

Research Functions.

The teachings of the Department of Agriculture are based, not upon the "opinions" of experts, but, as far as practicable, upon proven facts ascertained by research and investigation. This work is undertaken at the State Farms at Werribee, Rutherglen, Walpeup, and at Burnley; at the State chemical laboratories, at the Biology branch, at the Government Cool Stores, and on experimental plots conducted by the Department on 105 private farms. A highly qualified scientific staff is engaged on the work, but it is by no means large enough to cope with the many problems with which agriculture is faced. Research and investigation have already solved so many baffling problems and clearly shown the possibilities of increasing production and reducing costs in so many directions, such as in the field of wheat-breeding and in pasture top-dressing, that the numbers of workers in this field should be increased.

Competent research workers and investigators do not grow on trees. Their training takes years. Such officers are invaluable to the Department and to the State, and one cannot help feeling perturbed at the continual drain of

such officers to other States, and to the secondary industries which, on a number of occasions recently, have outbid the Department for some of its best men.

The two fields in which the most spectacular results of departmental research have been obtained are in wheat and in pastures. The translation of the research efforts of the departmental officers in these directions into practice on the farms has reduced costs, and added many millions to the wealth of the State. Recently, the value of one wheat variety bred by the Department has been publicly questioned on the ground that it is deficient in baking quality, but I would point out that over 90 million bushels of wheat of that particular variety, Free Gallipoli, have been gristed here and abroad mainly in the past five years, that the farmers have received over £14,000,000 for it, and that it has returned growers more than £2,500,000 in excess of what they would have received from the varieties it replaced. It has been stated that this variety is not acceptable abroad, and pointed attention has been drawn to the fact that last year and this some Victorian cargoes have brought from 1s. to 1s. 6d. per quarter less than West Australian. This is claimed to be due to low-baking quality but, while there is any amount of evidence that the price for certain cargoes is below West Australian, no evidence has been produced to show that the price depreciation is due to deficient strength. Until that is done, it is a reasonable inference to attribute the price difference to the poor appearance of the Victorian sample for the past two seasons, due to rain damage.

The overseas miller obtains his strong wheat from Canada, and does not buy Australian wheat for its strength, but for its ability to mill a high percentage of flour capable of giving good colour and flavour to the loaf. The Australian miller, on the other hand, has no such source of high-strength wheat, and hence the increasing percentage of low-strength wheat being grown in Victoria has caused him to be concerned as to where he can obtain the necessary strength for his blend. As stronger wheats cost more to produce than varieties such as Free Gallipoli, the question arises as to who is to meet that extra cost—the producer, or the miller?

Speaking of Australian wheat, Fisher and Jones (Research Association of British Flour Millers, 1932) said, "In certain respects Australian is definitely a more valuable wheat than U.S. Hard White. In milling properties it is, almost without exception, the finest which comes to this country (England). Its bushel weight is high and, possibly with one exception, it affords a higher yield of flour than any other commercial wheat. Its profitableness in this respect is enhanced by the fact that its moisture content is very low (10 to 11 per cent.). . . . The milling quality of the wheat embraces the fact that its flour, even when of great length, is usually of quite exceptionally good appearance. . . ."

Referring to Australian wheat in the blend, Fisher and Jones also say, "There are, for example, wheats of a weak type, small proportions of which distinctly improve a grist of normal all-round quality. Again, a wheat which

The Plant Research Laboratory at Burnley.

Strain investigations at the Pasture Research Field, Burnley.

is objectionable when baked alone on the score of shortness and clay-like handling of the dough, may have great blending value (in moderate proportions) owing to its improvement of the body of the mixture. Such a wheat (of which Australian is an example, and Karachi a still more conspicuous one) may give, itself, a dough of only moderate stability and yet may have the power to help the stability of the blend.

"Though Australian wheat has not this power to the same extent as Karachi, yet it is often of value in helping the body of an unduly 'tender' dough. With a normal blend, reasonably small additions (up to 20 per cent.) in no way hurt the dough, and the loaf may be rather bolder and of better all-round crumb quality (especially in colour). With heavier additions, however, the Australian characteristics sooner or later show themselves.

"One of the reasons for the popularity of Australian wheat (it should be remembered that the wheat gives a high yield of flour of excellent colour and bloom) is that it is plentiful at the same time as Plate, and the combination of the two was reputed to be very good."

Sir Albert Humphries, the 1932 chairman of the Home-grown Wheat Committee and of the British Millers' Association, on the baking quality of wheat, said (New South Wales Science Bulletin, 44, December, 1933):—

"Very broadly, the overhead trend has been towards a general falling off in the strength of Australian wheats." He remarked, also, that "when discussing the desirability of altering the type of Australian wheat, you should not attach too much importance to the present (May, 1932) relatively high price of strong wheats. We may, in a few years' time, if the supply of strong wheats be increased, find that the weaker wheats demand fully as much, or even higher, prices than the strong."

Summing up the question of improving the quality of wheat in Australia, Sir Albert Humphries says:—"The overriding consideration, to my mind, is the economic results, i.e., the return which the producer obtains, and whatever the quality of the wheat may be, I would make it subservient to the commercial interests of the producer."

The matter is a most important one, and I am hopeful that, with the exercise of a spirit of co-operation between the two parties whose interests are in apparent conflict, the difficulty will be overcome.

Recently, Ghurka has demonstrated its yield capacity to be at least equal to that of Free Gallipoli in many districts, and it is more rust-resistant. It is a rather better baking variety than Free Gallipoli, but it has a very short straw, and hence should not be used where weed competition is to be feared.

A sudden change over to varieties of better strength has been strongly urged, but I regard the sudden elimination of varieties proved to yield well under adverse conditions, including drought, for varieties not so well tried, as unsound.

Seven years ago the Department appointed a plant breeder and a cereal chemist especially to improve the quality of Victorian wheats. Considerable progress has been made, but the work of combining strength and yield under Victorian conditions is extremely difficult, although one may be reasonably optimistic as to its outcome.

There is no more profitable field for research than that of pasture improvement. Thanks to the funds provided by the Victorian Pasture Improvement League, the Department has been enabled to greatly intensify its efforts in the moister districts of the State, and to offer authoritative information on such questions as the best pasture species and pasture strains for those districts, the kind and quantity of fertilizer to apply and when to apply it. The claims made for the use of nitrogenous fertilizers were shown to be largely unjustified; unexpectedly potash was proved to be a useful fertilizer in one or two districts but, in most cases, lime failed to advantage the pastures.

Many valuable strains of subterranean clover, rye-grass, cocksfoot, and White Dutch clover have been isolated at the pasture-breeding grounds at Burnley, but except in the case of rye-grass, Victorians have shown very little inclination to enter the seed business for the purpose of raising and distributing the new seeds. The example of Colac, Kyneton, and Malmsbury might well be followed by others, and a profitable industry added to the State.

The new strains have many valuable qualities such as earliness, leafiness, drought resistance, perenniality, great vigour, and adaptability to special localities. As a rule the seeds do not differ from the ordinary commercial strain, hence, as they ought to command higher prices, are liable to substitution or adulteration. To prevent this the marketing of seed in original packages is essential, and it is necessary that the purchaser shall be satisfied that the pasture from which it is derived is of the approved strain. Certification of both field and package as being the right strain is desirable. Under the Colac scheme the field is certified to by the Department, and the local organization guarantees the contents of the package to be true to label. This is not altogether satisfactory, and the Department hopes that, under the new Seeds Act, authority will be given for a fully-controlled Government certification scheme.

There is so much investigational work on hand that it is impossible to more than illustrate the type of work being undertaken. A typical example of successful research is the development of the pear export trade. Ten years ago the export of pears of the William type was regarded as a hazardous enterprise, and failures were frequent. Cool storage investigations were directed to devise conditions under which the cool storage life of the pear could be prolonged. The pear was so short-lived that it was necessary to conserve every day of its life. By picking at the proper maturity, immediately pre-cooling to arrest maturation, railing in ice trucks to the ship and later in England ripening under controlled temperatures, success was obtained, and a new industry built up. Ten years ago the export of pears was scarcely 10,000 cases per annum, but it has now reached 400,000 cases a year.

An example of the type of problem with which the Department is continually being confronted is that of the oriental peach moth, an insect resembling codling moth, which made its appearance in Victoria in 1922 in the peach crops of the Goulburn Valley. The usual spraying methods failed to check it, because the grub rejects the skin of the peach when entering. Last year this pest severely damaged the Pullar Cling crop in the Goulburn Valley, and caused heavy loss to the growers and to the canneries, estimated to have reached £40,000.

The industry found the sum of £1,300 and, by arrangement with the Council for Scientific and Industrial Research, a full-time research officer has been assigned to this problem.

Yet another example of recent research is that in connexion with bacterial blight of beans. Orbost is the principal district in Australia for the production of seed of Canadian Wonder beans. A few years ago a serious disease, bacterial blight, beset the industry and caused heavy losses. The problem proved a most baffling one, but this year a new strain has

Aerial view of section of the experimental area at the State Research Farm, Werribee.

been evolved which has proved outstandingly resistant to the disease, and promises to solve the problem.

Advisory Functions.

Farming communities the world over are notoriously slow to change methods. The number of individuals in a factory who have to be convinced of the value of a new process is relatively few—sometimes only the manager, at the most, a Board of directors.

In agriculture there are thousands of free and independent units, and each one of these has to be won over. The conditions on each farm vary, and the distance that separates the farm is, in itself, a formidable barrier to the spread of knowledge. True, there are many farmers who are as receptive to new ideas as any manager of a factory, but there is too great a time lag before the majority adopt the change. For example, it took ten years' hard work by the Department before the proven facts of top-dressing were widely adopted. There was much passive and even active opposition to the change. Eventually it was accepted, but the delay must have cost the industry as a whole more than a million pounds.

Many other such examples could be quoted, and it can be stated that the great barrier to progress in agriculture is not, in general, the rate of solution of agricultural problems, but the delay in putting them into effect. If all the proven facts of research in agriculture applicable to Victorian agriculture could be put into effect immediately, it is safe to say that the production of this State could be doubled.

But the passive resistance to change in communities of producers—which, owing to the advent of the telephone, wireless, and the automobile has become markedly reduced—must be faced and overcome by organized methods. It is absolutely fundamental that no information be given the departmental stamp of approval unless it has been proved to be thoroughly sound. The officers concerned must be thoroughly conversant with the farmer's point of view and with his problems, and they must also be well versed in the facts of research. Seeing is believing, and the best medium for bringing facts before the producer is practical demonstrations in his own district. The Department has 105 such demonstration plots on private farms as well as those on the State Farms. Other aids are field days, lectures, wireless talks, the press, bulletins, and that travelling technical college on wheels, the Better Farming Train. A not unimportant factor is the influence in their own district of leaders of local thought. But despite all these aids progress is slow, and agricultural leaders both here and abroad have turned hopefully to the younger generation. The country boy of to-day will be the farmer of to-morrow. His mind is still plastic, and he is

naturally a better propagandist in the home than any one outside the family can possibly be. The Department believes the Boys' Farm Clubs to be an invaluable aid to agricultural progress, and stands solidly behind this movement, which is shaping so well in Victoria. Already the number of clubs is so great that, with the present staff, the Department finds itself quite unable to provide the advisory services required. The success of such movements depends on the quality of the information given, and without the guidance of technically sound instructors the work could do more harm than good.

Visual instruction is the most convincing, but Departments of Agriculture in Australia, owing to shortage of funds, have not been able to make much use of the outstanding technical development of the age in that regard—the movie camera and film. It is a weakness which should be remedied.

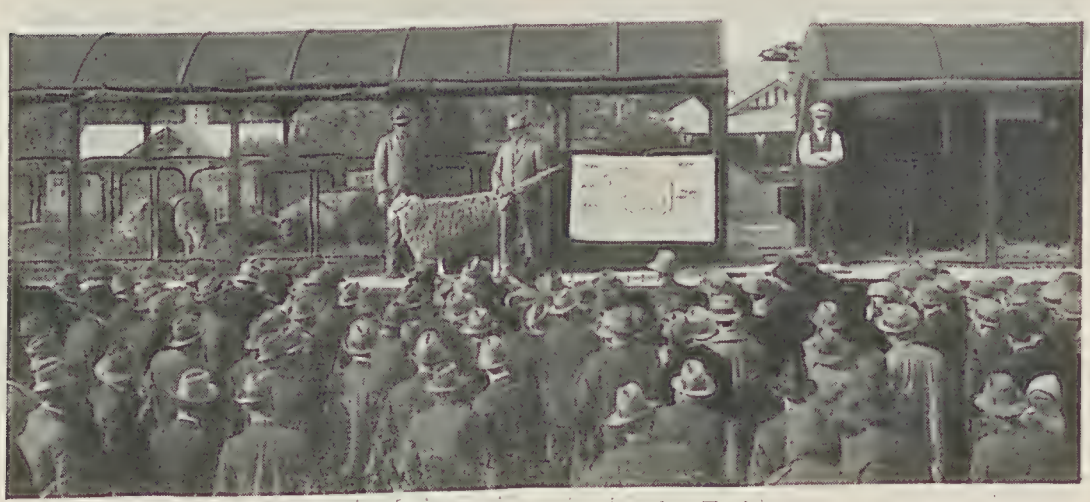
The Organization.

The Department of Agriculture, as has been shown, is intimately concerned with the co-ordination as a whole and with the improvement of the State's greatest business, Agriculture. The problems are difficult and highly technical, and they must be speedily dealt with, and a practical solution found. In the industry, emergencies are frequent and must be met.

The present staff comprises 526 persons, including employees at the Maffra Sugar Factory and the Government Cool Stores. In all there are 198 qualified professional officers, of whom 47 are University graduates. This staff may seem large, but experience has shown that it is all too small to cope with the work, especially to meet the continual emergencies as they arise.

There is especially a deficiency of "Shock troops" to meet the sudden outbreaks of disease both of plants and animals, or to conduct an offensive upon an urgent problem such as quality uplift in butter.

Just as there is a marked lag effect in the farming community to new methods, so there is in the general community to the staffing requirements, especially of technical officers, necessary to keep the Department up to date. Attention is sometimes drawn to the fact that the vote of the Department is large—£340,885 last year—but it should be realized that a considerable portion of this is incurred in connexion with the Department's business enterprises, and that it is offset by revenue, £313,419 last year; so that the net cost to the taxpayer in that year for all services was £27,736, surely, a very modest sum considering the magnitude of the task, the service given and the distances that have to be travelled. Contrasted with the total annual value of wealth produced by the industry, its importance in the economic future of the State, and the possibilities there are for improvement and for setbacks by disease, it is very small indeed.



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Lucerne Growing

Cultivation Hints

By L. C. Bartels, B.Agr.Sc., Senior Agrostologist

A good crop of lucerne at Bacchus Marsh.

LUCERNE is a very valuable crop which should be regarded with much greater importance in Victoria than it is at present. It has been the foundation in the development of the irrigated closer settlement areas of the State, but it presents, also, opportunities for extended sowings under natural rainfall conditions.

Lucerne is a perennial plant, which grows over a wide range of conditions. It grows best in deep loamy soils, and flourishes in semi-arid conditions where irrigation water is applied to supplement the rainfall. It is a very deep rooter, and this characteristic enables it to withstand dryness, but it will not grow in water-logged soils.

Under favorable conditions, lucerne is very productive, and will produce, during the summer, a succession of growths which are available for cutting at intervals of five to six weeks. Ordinarily under irrigation, five cuts are made and, although these are not uniform, aggregate yields of 5 tons of air-dried hay may be expected. Yields of as much as 8 and 9 tons of hay per acre have been harvested at Werribee in one season, while a single cut of 52 cwt. per acre has been recorded both at Werribee and at Swan Hill.

Under dry conditions yields depend on rainfall, but on river and creek flats, where moisture in an underlying water table can be tapped by the penetrating roots of the plant, lucerne grows luxuriantly.

Lucerne is best adapted for cutting for hay or green forage, although it is grazed extensively with satisfactory results. It must be pointed out, however, that continued grazing shortens the life of the plant. This crop provides a most valuable fodder which is eaten readily by all classes of farm animals. Being a legume, the herbage has a high nitrogenous content, and it is characterized also by a high proportion of lime and other minerals. The first sowings of lucerne in many of the irrigation districts have remained dense and productive for periods of ten years or more, and

normally seven years of useful life may be expected. Under dry conditions lucerne will remain profitable for longer periods providing precautions are taken to avoid abuses in grazing.

As a result of investigations carried out by the Department of Agriculture much information is available concerning the factors which govern the growth of lucerne. Because it is a long-lived productive plant it deserves a good start, particular importance being attached to the prepartion of the seed-bed, and, where irrigation is to be practised, to the grading and checkbanking of the land.

It is not advisable to sow lucerne in virgin ground. A cereal should be grown as a preliminary crop, particularly when land has been recently cleared of timber. The deepest and best drained land available should be selected, and in preparation for sowing, the paddock should be fallowed to secure a good, firm seed-bed, and one that will be free from weeds. Sowing should be carried out during the autumn or spring, the latter being the most favorable time in the southern parts of the State.

Local Seed Superior.

Farmers should not pay too much attention to extravagant claims which are often made in favour of imported lucerne seed. As with most other agricultural seeds, careful tests have shown the superiority of strains that have developed in Australia and which are the product of many years of natural selection. In comprehensive trials of lucerne seed from all sources, the Hunter River strain has surpassed all other forms. Although some of the varieties, such as Provence, produced a finer hay, the Hunter River type proved a heavier yielder, and, when handled properly, provided good hay.

Land graded for lucerne at Werribee.

In other countries where the severity of the winter climate or the tropical conditions are unsuitable for ordinary lucerne, varieties such as Grimm and Hairy Peruvian find a place. Under average conditions in Victoria, however, these types are not recommended. Grimm lucerne makes poor growth during the autumn, and is quite dormant during the winter. In addition, a crop of this variety is likely to be infested with weeds. Hairy Peruvian is recommended by some who apparently are impressed by the robust appearance of the plants. In contrast to Grimm it makes fairly good growth during autumn and winter but, under field conditions, it soon becomes sparse and produces a coarse hay. Growers in Australia are protected to some extent in that all imported seed is dutiable, unless it contains a proportion of stained seed. As a result, if reddish seeds are observed in a sample, it will be known that it is not of Australian origin.

Seeding.

A seeding of 8 to 10 lb. per acre is ample, and it is recommended that superphosphate at the rate of 1 to 2 cwt. per acre be applied with the seed. The manure and seed may be mixed together just before sowing and sown through the fertilizer run of the drill. The drill is let into the ground, but the tubes may be withdrawn and allowed to hang free. A looped chain attached to both sides of the drill, and trailing behind, will cover the seed sufficiently.

During the first two months of growth the young lucerne should be left alone. A belief exists that the young plants should be clipped to stimulate growth, but there is no justification for this. Very often when weeds grow abundantly and threaten to smother the lucerne seedlings, mowing will retard weed growth, but, if the young stand is clean, it should not be mowed till the first growth gives place to new shoots, and even then it is not essential.

Grading Land.

Land to be sown with lucerne for irrigation should be laid out on the border system, which means that the paddocks are divided into long narrow bays by banks which run down the slope, and the land between these banks is levelled from side to side. The dimensions of these bays vary with conditions, but usually they are half

Raking and cocking lucerne prior to stacking.

to two-thirds of a chain wide. Where side-fall exists in the land the narrower bays are desirable. The length is governed by the slope and porosity of the ground, 10 chains usually being suitable, but in porous soils shorter bays are desirable. A fall of 2 to 3 inches per chain is a favorable one. Flat grades are not suitable for lucerne, and where they exist the bays should be shortened to prevent water lying on the land.

It is very desirable that the land for lucerne should be graded properly to permit an even distribution of water, and to secure uniform growth, as well as to avoid injury to the stand by water lodging in depressions. Generally, careful grading necessitates extended preparation, and if practicable the land should be roughly graded a year prior to the final operation. This permits any filling to settle.

Rate of Watering.

Although it is desirable that the lucerne should be brought up by rain, the land is often irrigated when the seed-bed is so dry that conditions are unsuitable for germination. It is preferable to irrigate before sowing, because if carried out after sowing crusting of the surface often occurs, and the young seedlings are unable to penetrate the top layer of soil. This danger is not so great on sandy loam soils.

It has been determined that in the growth of lucerne it takes 600 tons of water (irrigation and rainfall) to produce 1 ton of lucerne hay. This fact may impress growers with the necessity for adequate water supplies if high yields are desired. Experiments at the State Research Farm, Werribee, have established the fact that 2 feet of irrigation water per annum produces best results and, further, this amount of water is most efficacious if it is given in six waterings, each of 4 inches, distributed as follows:—One watering between the first and second cuts, two waterings between the second and third cuts, two waterings between the third and fourth cuts, and one watering after the fourth cut.

In relatively absorbent ground the ideal may be achieved. In practice, however, it is difficult to get 4 inches of water into much of the land with one watering in our irrigation settlements. In such cases the lucerne may be dwarfed unless a more frequent watering programme is adopted.

Because water cannot always be obtained as required, it has been found advisable to attempt to secure better penetration of the water by what is called supplementary watering, i.e., by repeating the irrigation a day or

Stacking lucerne hay.

two after the first watering. This second watering may be carried out in much less time; the water will travel faster and spread better than during the initial watering. If land is flat or badly graded, extra watering is likely to aggravate any troubles which may arise from extra watering, as it must be realized that lucerne suffers more often from over-watering than under-watering. The relation between the water used and the land it serves is important, and very often when the growth of lucerne is not up to expectations an explanation will be found on examination of the subsoil by digging or boring when it will be found to be unwetted.

A well covered hundred-ton stack of lucerne at the State Research Farm, Werribee.

Top-dressing.

Top-dressing is of the greatest importance in lucerne growing. For many years the Department of Agriculture has conducted tests, first at Werribee and later at centres such as Swan Hill, Rochester, Tongala, Stanhope, and Cohuna, and in all cases the results in regard to manurial treatment, have been in agreement. They demonstrate the need for phosphatic manuring, and superphosphate has proved the best means of supplying the deficiency. Annual dressings of 4 cwt. per acre have doubled the yield at Swan Hill, while 6 cwt. per acre trebled the yield of hay, raising it from 3 to 9 tons per acre. These results were sustained over many years, and, further, lucerne, which was becoming thin and sparse, was completely rejuvenated and maintained its vigor. The invigorated lucerne was able to dominate weeds and even such types as *Paspalum dilitatum* and *Paspalum distichum*, were completely suppressed on manured plots while they increased on the adjoining unmanured plots. Manured lucerne also makes fair growth during the winter.

It is recommended that an annual application of at least 2 cwt. of superphosphate per acre be made on irrigated lucerne, and the evidence is that double this quantity will pay. Under dry conditions a minimum of 1 cwt. per acre is desirable. In no case in the tests has lime or gypsum been as efficacious as extra superphosphate. The contrast between unmanured and manured lucerne is greatest during the autumn and winter, thus its fertilizer requirements are best indicated at this time. Superphosphate may be applied from a drill or broadcasting machine, or even broadcast by hand, and it may be put on with advantage at any time of the year.

One very important benefit from top-dressing with superphosphate which was disclosed in the experiments, was its effect on the penetration of moisture. In the trials the plots are laid down across the bays and irrigation water runs across them. In spite of this the borders are well defined. At Tongala trenches were dug across the junction of two plots receiving no manure and 4 cwt. of superphosphate per acre, and the difference in the soil within very narrow limits was remarkable. On the unmanured land the soil was dry and the roots of the lucerne did not descend below 2 feet; but on the manured section trenching was easy, the ground was moist to the full depth of 6 feet, and many of the lucerne roots were down to that depth. The soil at Tongala is a clay loam—typical of much of the Goulburn Valley. In profile this soil shows 5 inches of surface soil underlain by a compact band of clayey character some 15 inches in thickness. This makes a barrier to the descent of moisture, but the indications are that heavy manuring surmounts this difficulty.

Cutting for Hay.

Best results are obtained from lucerne if it is cut regularly, the time of cutting influencing the amount and quality of the product.

In tests at Werribee lucerne which was cut regularly before blooming gave six cuts in the growing season. When cut just after early blooming five cuts were obtained, and when cut in full bloom four cuts were removed each year. The five cuts taken just after bloom appeared gave the biggest yield, and at that stage the lucerne made fair quality hay. For these reasons and because the shoots of the new growth are making their appearance at this stage, it is the best time for cutting. The best hay was obtained from the early cut lucerne, while that which was cut in full bloom yielded the poorest quality hay. At the end of five years the lucerne which had been cut regularly in the immature stage was poorer than that on the other plots, the best stand being that on which the crop was allowed to mature fully before cutting.

Weather conditions during hay making determine the quality of lucerne hay, and if wet conditions are experienced some damage is inevitable. The leaves of lucerne contain most of the nutriment, and every endeavour should be made to keep them intact.

When the lucerne is mown it may lie in the swath for a time according to the judgment of the farmer, but, except under very cool conditions, it should not be left longer than one day. Usually it is advisable to rake the lucerne into windrows soon after cutting in order to retard the drying. To make good lucerne hay, the material should be put into cocks. These involve considerable work, but it is justified because cocking the lucerne allows it to be cured with the least exposure to rain and sun. The cocks facilitate carting and stacking also. Careful stacking will help to deflect rain, but the nature of the hay is such that some cover is desirable for stacks.

A few years ago the practice of scarifying lucerne during the winter was firmly established, but experiments have failed to show any benefits arising from this procedure beyond the reduction of annual grasses in the first cut.

Phylloxera-resistant Vine Rootlings and Cuttings

CONDITIONS under which Victorian vine-growers may purchase phylloxera-resistant vine cuttings and rootlings (grafted and ungrafted) from the State Vine Nursery at Wahgunyah during the current year are now available, and copies may be obtained on application to the Department of Agriculture, Melbourne.

The 1933 season's printed conditions are again being used, but applicants are advised that the dates as stated therein must in every case be advanced by two years.

For grafted rootlings (1936 distribution June to August inclusive), applications will be received until 1st June. For the 1935 distribution the time for receiving applications closed on the 20th June, 1934, and present applicants cannot be supplied until 1936.

For ungrafted rootlings, to be distributed from July to August, 1936 inclusive, applications will be received until 1st June, 1935. After these dates applicants can be supplied only in the event of there being a surplus when all regular applicants have been satisfied.

Applicants are required to decide finally, when filling in their application forms, as to their stock and scion requirements, as no amendment can be permitted later.

It will suffice here to explain that resistant vines are supplied to intending planters in any of the following forms, and at the prices stated (packing extra when consignments are forwarded by rail):—

Resistant rootlings, grafted with scions previously supplied by applicants, at per 1,000—£20 (deposit, £2 10s. per 1,000).

Resistant rootlings, ungrafted, at per 1,000—£5 (deposit, £1 per 1,000).

Resistant cuttings, at per 1,000—£2 10s.

No application will be entertained unless made on the forms supplied for the purpose, which are obtainable from the Superintendent of Horticulture, Department of Agriculture, 605 Flinders-street, Melbourne, C.3; or from the Manager, Viticultural Station, Rutherglen.

Separate forms are provided for (*a*) grafted rootlings, and (*b*) ungrafted rootlings and cuttings. Applications must be filled in on the proper forms, and accompanied by a deposit as specified above.

Grade Herd Testing

Annual Report, 1933-34

By W. J. Yuill, Senior Dairy Supervisor

THERE was a gradual increase in herd-testing in Victoria from the time of its introduction here until the spring of 1934, when a decline in numbers was evident, becoming very marked before the end of the year. As compared with the year immediately preceding, the number of herds being tested throughout the State declined by 400, and the total number of cows by approximately 10,000. The number of cows under test, however, is still considerably above the level of every year prior to 1933-34.

During the three years' period from 1929-30 to 1931-32, the average size of the grade herd under test remained stationary; since then, there has been an increase of 2.7 cows per herd. Each area shows an increase in herd size; it is most marked in the western area. The irrigation districts also show a definite increase in this respect. Gippsland remains practically unaltered; its average is about equal to that of the grade herds being tested throughout the State. This is also the case with regard to average yield of butter-fat per cow.

Reason for Losses.

At the outset, it can be definitely stated the attitude of the Victorian dairy farmer to herd-testing work has not materially changed. This is evident from the fine audiences that attend the many organized field days and conferences.

Mr. P. Gannon's four-year-old "Ponsie," which yielded 735 lb. butter-fat and was first of the "Twenty Leading Cows".

Table I.—High-producing Herds of Less than 20 Cows Ranged according to Production.

Owner.	Address.	No. of Cows.	Average Yield Butter-fat.
			lb.
A. J. Robinson ..	Rochester ..	12	442
P. Freestone ..	North Murchison	16	410
G. Beasley ..	Swan Hill ..	18	396
C. J. Pierce ..	Rochester ..	17	381
G. Curran ..	North Murchison	11	377
D. Christie ..	Rochester ..	19	370
J. Phillips ..	Swan Hill ..	19	369
J. Swarbrick ..	Sale	19	366
Geo. H. Bright ..	Dumbalk North	13	366
J. C. Gilham ..	Rochester ..	18	363
H. Stirling ..	North Murchison	12	360
H. MacRae ..	Rochester ..	14	359
J. McLeod ..	Bunyip ..	12	359
J. Magee	Maffra ..	10	357
W. Waterhouse ..	Pakenham ..	16	356
T. Sullivan ..	Kyneton ..	15	356
W. Leckie ..	Milewa ..	10	356
C. Jennings ..	Peninsula ..	14	343
A. E. Saunders ..	Maffra ..	10	353
T. Collins	Yinnar ..	18	344
J. Black	Condah ..	17	342
J. Watson ..	Yinnar ..	19	341

During last year bad dairying conditions prevailed over a large portion of the State. A prolonged winter was followed by an early hot summer, the result being that poor pastures were general. Caterpillar plagues did much damage in Central and South Gippsland, while the tragic flood at Orbost caused unprecedented damage to pastures and crops, as well as loss of stock. However, splendid summer and autumn rains fell over much of the North-East and a portion of Eastern Gippsland, which produced a rich growth, but generally this came too late to renew the milk yield.

Conditions in South Gippsland during the autumn of 1934 were probably worse than those experienced for a great many years before. Some idea of the severity of the season in the south-western area may be gauged from the fact that water supplies failed on many farms.

As more than 70 per cent. of the tested cows were in the south-east and south-western areas, it is not difficult to account for the decline of the average butter-fat yield by 29 lb.

Portion of the herd of Mr. J. G. Howell, of Leongatha. The 34 cows in this herd averaged 378 lb. butter-fat.

We must, however, look elsewhere for the cause of the loss of membership. Bad seasons have come and gone during the past thirteen years without previously checking the upward trend of the movement. In the decade prior to 1929, dairy-farmers were favoured with a high level of butter-fat prices. For portion of this period the Paterson scheme was in operation, and the approximate price for the whole ten years was 1s. 6d. per lb. The high return maintained within Australia by artificial means undoubtedly drew many men to the industry who had but little knowledge of dairying, while long-established dairy-farmers increased the numerical strength of their herds. During the ten years ended by 1929 the number of dairy cows in Victoria increased by 50 per cent., and the amount of butter exported from Australia was doubled. With the world depression, the effects of which began to be felt here in 1930, the price of butter-fat gradually fell until now, as for the last couple of years, it is only 9d. per lb.

In order to appreciate fully the grave difficulty in which the dairy farmer finds himself,

TABLE II.—HIGH-PRODUCING HERDS OF FROM 20 TO 40 COWS RANGED ACCORDING TO PRODUCTION.

Owner.	Address.	No. of Cows.	Average Yield Butter-fat.
			lb.
J. D. Pierce ..	Rochester ..	21	422
E. Swayn ..	Stanhope ..	28	416
T. MacClusky ..	Tongala ..	21	407
T. Glover	Loch	34	406
J. Sillars	Narracan ..	25	401
H. H. Prime ..	Winchelsea ..	28	399
R. and A. MacClelland	Geelong ..	24	393
R. Rautman ..	Maffra ..	25	391
H. Sharples ..	Jindivick-Neerim	27	387
E. Neave	Traralgon ..	20	384
O. Thaw	Stanhope ..	24	383
J. Bennett ..	Yinnar ..	20	379
J. G. Howell ..	Leongatha ..	34	378
G. Stanlake ..	Loch	21	377
T. M. Noble ..	Maffra ..	21	376
A. J. Evans ..	Swanpool ..	30	366
J. H. Whiston ..	Bunyip ..	20	365
W. Swarbrick ..	Sale	22	364
L. Peace	Cohuna ..	34	363
E. Skinner ..	Gellibrand ..	20	363
E. Tackerberry ..	Mirboo North ..	21	361

TABLE III.—HIGH-PRODUCING HERDS OF FROM 40 TO 60 COWS RANGED ACCORDING TO PRODUCTION.

Owner.	Address.	No. of Cows.	Average Yield Butter-fat.
			lb.
R. W. Bjorksten ..	Toora ..	41	376
Kelliher Bros. ..	Jindivick-Neerim	67	371
D. Mathewson ..	Maffra ..	57	358
H. Furphy ..	Dumbalk ..	42	349
J. Trease	Dumbalk ..	55	347
W. W. Smith ..	Tallangatta ..	44	347
C. Tobin	Eskdale ..	54	340
R. Buchanan ..	Tallangatta ..	51	333
R. Turnbull ..	Tallangatta ..	44	323
J. Clyne	Maffra ..	65	326
J. Clyne	Maffra ..	66	325
A. M. Coolstock ..	Mountain View	50	321
P. Nichol	Tallangatta ..	46	319
J. Stockdale ..	Traralgon ..	50	317
J. Graham ..	Werribee ..	46	315
Walker Bros. ..	Yinnar ..	54	310
D. Nichols ..	Tallangatta ..	47	310
J. Yates	Leitchville ..	41	309
W. Mahoney ..	Warrnambool ..	52	303
J. E. Attenborough	Yarram ..	49	301

TABLE IV.—HIGH-PRODUCING HERDS OF FROM 60 TO 80 COWS RANGED ACCORDING TO PRODUCTION.

Owner.	Address.	No. of Cows.	Average Yield Butter-fat.
			lb.
Batten and Sons ..	Warrnambool ..	71	337
Mrs. Cardwell ..	Eskdale ..	67	327
R. Cardwell ..	Eskdale ..	64	327
W. Wheelden ..	Warragul ..	66	321
J. Waite	Traralgon ..	64	311
J. A. Ford ..	Kiewa Valley ..	65	310
W. H. Hannan ..	Winchelsea ..	61	306
G. Nixon	Eskdale ..	70	302
T. Major	Cohuna ..	67	299
J. M. Sexton ..	Nalangil ..	72	291
H. Andrews ..	Eskdale ..	61	290
Hamilton Bros. ..	Dumbalk ..	61	285
C. Cross	Eskdale ..	70	284
T. Ley	Eskdale ..	70	283
A. J. Axford ..	Kongwak ..	65	279
Mrs. L. Lee ..	Cohuna ..	64	270

it must be remembered that, generally, land values in this State are unusually high; the value of the area required for each cow may be set down at approximately £100 per cow. With butter-fat at 9d. per lb., a herd of 30 cows averaging 300 lb. fat will bring in £337 10s. per annum. (With returns from pigs the income might in some cases be increased to £400.) From this amount must come all the farm working costs, including interest, taxes, rates, seeds, fertilizers, depreciation, bull cost, living expenses, labour cost, &c.

The annual yield of dairy cows in Victoria is 170 lb. butter-fat. Thus the weekly return from thirty average cows would be about £4; even if pigs and calves are taken into consideration the amount would still be under £5—and this for a two-man job.

As income lessened from year to year farmers were compelled to forgo luxuries and then necessities. Some men have reluctantly withdrawn from testing work because the matter of finding the few pounds payable as fees has become increasingly difficult. Of course, the suggestion of restriction of exports and the fixing of quotas, &c., has had a disquieting effect, and one sometimes hears doubts expressed as to whether testing and culling is worth while; indeed, one is called on to answer the question, "Is the expense of continuous herd-testing justifiable?"

Since the inauguration of organized herd-testing in this State, much information has

"Poppy," the top cow in Mr. Howell's herd, with 522 lb. of butter-fat.

been disseminated regarding the work. Most farmers to-day know that milk which may well deserve the description of "rich looking" may be low in butter-fat content. They have been convinced, too, that testing a cow for a week, or even a month, of any lactation is of little value in ascertaining the average test of her year's production, and that one year's record is not sufficient on which to determine the class in which any cow will eventually be placed. Further, farmers to-day have learned that many factors, such as age, feeding, management, length of previous dry period, may have a very definite influence on yield.

The variability of the characters for milk yield and test according to breed is largely known, as is also the extraordinary variations within the breed, and even within any one family of a breed. The effect of feeding a balanced ration throughout the lactation

TABLE V.—HIGH-PRODUCING HERDS OF MORE THAN 80 COWS RANGED ACCORDING TO PRODUCTION.

Owner.	Address.	No. of Cows.	Average Yield Butter-fat.
			lb.
J. Moore and Co. ..	Yarram ..	100	289
J. Mitchell ..	Swanpool ..	95	289
Foster Bros. (No. 4)	Maffra ..	82	279
J. Coolahon ..	The Sisters ..	83	273
J. Moore and Co. ..	Yarram ..	127	267
W. Evans ..	Gellibrand ..	88	268
— Woodmason ..	Camperdown ..	94	257
J. Mahoney ..	Kolora ..	123	223
G. M. Black ..	Tarwin ..	98	218
A. M. Black ..	Tarwin ..	74	218

Carting lucerne hay on Mr. E. A. Swayn's property at Stanhope.

period is now general knowledge. By visits of the Better Farming Train and by field-days throughout the State, these lessons have reached thousands of dairy farmers.

More than twenty years have elapsed since the foundation of organized testing was laid, and the evidence gained in that time has demonstrated that continuous testing is not only desirable, but essential. That also is the opinion of all the officers of the Department of Agriculture who have taken part in herd-recording work.

As test work proceeds, very definite features present themselves, revealing characteristics in certain families. Some become noted for consistently high production; others for considerable variation. Some families appear to have a marked resistance to disease; in others there is an undue number of shy breeders. Only continuous testing will reveal the great disparity that exists between the individuals in any herd.

A survey of production records representing many years of testing work invariably indicates that some families are long lived; in others the reverse characteristic is observable.

Longevity and a high degree of resistance to disease are very desirable qualities in a dairy cow only when her record proves her to be a profitable producer. It is not uncommon to hear of a cow with one or more good yearly yields, but whose average return over a series of years is very disappointing. There are plenty of cows that year after year give a yield of 400 lb., and are more deserving of a foremost place than the animal that produces 500 lb. of butter-fat, and then falls away to 350 lb., and never rises above that amount. It is the high average that counts, and not the high yield during one year. Some cows will yield surprisingly well over a period of a few weeks, but "fade out" within six or seven months.

Bull index work has come to stay, but if it is to be successful, it will require continuous testing of herds, since comparison of yields of dam and daughters over many years will be necessary.

TABLE VI.—SUMMARY OF HERD TEST ASSOCIATION DATA FOR YEAR ENDING 30TH JUNE, 1934, AND COMPARATIVE FIGURES FOR PREVIOUS YEARS.

Area.	Units.	Herds.	Tested Cows.	Cows under Four Years.		Pure-bred Bulls in use.		Average Number of Cows in Herd.	Average Production per Cow.		
				Number.	Per-centage.	Number.	Per-centage.		Lb. Milk.	Per-centage.	Lb. Butter-fat.
Gippsland ..	52	1,155	35,007	16,475	47·0	854	75·0	30·3	4,612	4·6	212·0
Western ..	42	870	31,735	13,770	50·0	674	77·5	35·3	4,432	4·35	193·0
Goulburn Valley ..	22	524	13,988	7,769	55·0	392	74·8	26·7	5,564	4·38	244·0
North East ..	18	361	12,223	5,380	44·0	294	81·4	33·8	4,068	4·68	225·5
1933-34 ..	134	2,910	92,953	43,394	46·0	2,214	76·0	31·7	4,723	4·51	212·0
Data for Seymour, and Tongala No. II., not available.											
1932-33 ..	141	3,383	104,009	46,392	44·6	2,619	77·0	31	5,290	4·55	241·1
DATA OF PREVIOUS YEARS.											
1931-32 ..	130	3,098	89,619	36,946	41·3	2,323	75·6	29	5,393	4·58	247·3
1930-31 ..	132	3,085	90,360	32,867	36·4	2,251	73·0	29	5,383	4·30	234·0
1929-30 ..	116	2,604	76,032	24,439	32·1	1,653	71·0	29	4,944	4·59	226·1
1928-29 ..	96	2,229	63,277	19,246	30·4	1,354	64·0	30	5,080	4·38	223 3:

TABLE VII.—TESTED HERDS GROUPED ACCORDING TO AREA AND PRODUCTION OF BUTTER-FAT, 1933–4.

Area.	Herds.	Lb. of Butter-fat Range.						
		Over 400 lb.	350 to 400 lb.	300 to 350 lb.	250 to 300 lb.	20 to 250 lb.	150 to 200 lb.	Under 150 lb.
Gippsland	1,155	4	21	109	239	388	320	74
Western	870	1	8	35	117	334	313	62
Goulburn Valley ..	524	10	34	125	177	140	35	3
North East ..	361	4	3	45	76	128	94	11
Total ..	2,910	19	66	314	609	990	762	150
PREVIOUS YEARS' SUMMARIES.								
1932–33	3,383	53	154	476	993	1,141	479	87
1930–31	3,085	42	127	433	870	1,112	461	40
1928–29	2,292	9	46	181	396	789	559	139

NOTE.—There were 473 less herds under test during the year under review—a difference of 14 per cent. Thirteen per cent. of the herds exceeded the 300-lb. butter-fat level, while 5·1 per cent. fell below 150 lb. The difference compared with the previous year was mainly owing to the increase in the number of herds below this level in the Gippsland and Western areas.

The arguments for continuous herd-testing may be put briefly as follows:—

1. There is no other method of measuring the productive capacity of a cow.
2. There are many factors that affect the yield of any one lactation; only by continuous testing can a cow's average be ascertained.
3. Continuous testing is necessary to establish the breeding worth of a cow, or a cow's dam.
4. The only real measure of a bull's value is the difference between the production of his daughters and their dams. This information can be revealed only by continuous testing.

The Year's Results.

A review of the year's work indicates that there has been a setback in every section. One pleasing feature, however, is that the percentage of junior cows has increased. While this suggests a steady culling of the herds, it may possibly mean losses due to a higher incidence of disease as compared with ten years ago.

The percentage of herds in which there are registered pure bulls has been over 70 per cent. for the past five years. All areas are uniformly high in this respect, the north-eastern area leading with 81.4 per cent. In many

Mr. E. A. Swayn's "Silvermine," which yielded 400 lb. butter-fat as a senior two-year-old.

units, such as Kiewa Valley No. 2, Maffra No. 1, Warrnambool, and Swan Hill—to mention but one from each zone in the State—all the bulls are registered.

These associations occupy very prominent positions in their respective areas, but this should not be regarded as the result of the widespread use of pure-bred bulls, for in the leading unit of the year only half the bulls were pure-bred, and some units in which every bull was pure-bred are near the bottom of the list. Registered bulls are recommended, but proved bulls are in demand.

Rochester No. 1 Association was ½ lb. below the required 300 lb.; last year it was 20 lb. above it. In the Maffra No. 1 Unit, there were 1,046 cows under test, 47 per cent. of

Another view of Mr. J. G. Howell's herd. Four cows in this herd each yielded more than 500 lb. butter-fat.

which were juniors, and the yield was 15½ lb. butter-fat per herd below the high level of 1933.

Toora, Dumbalk North, Dumbalk, Narracan No. 3, and Leongatha No. 4—all units with many years of service—had averages exceeding 250 lb. butter-fat per cow; Winchelsea was the only unit in the western area to surpass this level.

Eskdale No. 1, Myrtleford No. 1, Eskdale No. 2, and Tallangatta No. 1, all pioneer units of the north-eastern area, also had averages above 250 lb. Eskdale No. 1 Association had the particularly fine record of 271.6 lb. for 906 cows, 33 per cent. of which were under four years at the beginning of the year's test work.

The Goulburn Valley and irrigation areas were down 10 lb. per cow in their average butter-fat as compared with the two previous years. It must be remembered, however, that not all the cows were milked on irrigation farms; the average was therefore affected by several influences. Ten units exceeded 250 lb. per cow; eight of them were over 260

"Peggie II," a mature cow in Mr. E. A. Swayn's herd, which yielded 548 lb. of butter-fat.

TABLE VIII.—TESTED COWS GROUPED ACCORDING TO AREA AND PRODUCTION OF BUTTER-FAT, 1933–4.

Area.	Total Cows.	Lb. of Butter-fat Range.						
		Over 800 lb.	Over 700 lb.	600 to 700 lb.	500 to 600 lb.	400 to 500 lb.	300 to 400 lb.	200 to 300 lb.
Gippsland	35,007	..	2	1	56	593	4,571	15,776
Western	31,735	..	1	2	23	213	2,590	14,078
Goulburn Valley ..	13,988	..	..	2	41	442	2,825	6,311
North-East ..	12,223	..	..	1	10	155	1,795	5,465
Total ..	92,953	..	3	6	130	1,403	11,781	41,630
COMPARATIVE FIGURES OF OTHER YEARS.								
1932–33	104,009	..	1	18	202	2,328	15,880	50,070
1930–31	90,360	1	5	25	219	2,415	16,044	42,278
1928–29	63,277	1	1	12	111	1,108	8,936	28,355

NOTE.—During 1933–34 46 per cent. of the individual members were juniors, i.e., under four years of age no age allowances are given. In all, 13,322 cows, or 14·3 per cent., exceeded 300 lb. butter-fat; 139 of these yielded over 500 lb. The highest yield was 735 lb.

lb., and four over 270 lb. The return at Swan Hill was 286.6 lb. per head; at Rochester it was 299.5 lb.—a striking testimony to the value of continuity of green fodder to sustain the dairy cow's milk yield.

Undoubtedly a factor to be considered when comparing the low yield of butter-fat for last year with previous years is the lessened quantities of concentrates used because of the very low butter-fat prices.

The Leading Herds.

The leading herd average for the year is that of Mr. A. J. Robinson, of the Rochester Association. His twelve cows put up the fine average of 442 lb. butter-fat, two of which were over 600 lb. Only one other herd of less than twenty cows topped the 400 lb. butter-fat mark, viz., that of Mr. P. Freestone, of Murchison East. The eighteen cows in the herd of Mr. W. G. Beasley, of Swan Hill,

TABLE IX.—TWENTY LEADING COWS, WITH DETAILS OF OWNERSHIP, IDENTIFICATION, AGE, PRODUCTION, AND BREEDING OF SIRE.

Owner.	Association.	Name.	Brand.	Lb. Milk.	Test.	Butter-fat.	Sire.
P. Gannon ..	Maffra ..	Ponsie ..	V : 2 / 3	13,885	5·3	735	Unknown
R. and A. McClelland	Geelong ..	Gray	5 : 12 / 26	12,867	5·6	721	Reg. Jersey
H. Graham ..	Traralgon ..	Doris ..	E : 79 / 25	10,843	6·62	717	Reg. Jersey
A. Robinson ..	Rochester ..	Lucy	R : 42 / 5	15,196	4·44	675	Grade Ayrshire
A. J. Matthey ..	Geelong ..	Rosebud ..	REGSTD	11,153	5·86	653	Reg. Jersey
D. Rae	Wonthaggi ..	Pansy ..	A : 42 / 17	11,322	5·74	650	Unknown
J. Knight ..	Toora-Welshpool	Babs	W : 36 / 1	11,750	5·41	636	Unknown
T. Clearie	Leitchville ..	Nellie ..	AH : 20 / 51	11,253	5·49	618	Reg. Jersey
Warner and McKenzie	Toora-Welshpool	Silver Belle ..	W : 42	11,251	5·48	617	Reg. Jersey
R. Turnbull ..	Tallangatta ..	Thelma ..	T : 3 / 1	9,253	6·64	615	Unknown
C. Tobin	Eskdale ..	Astor ..	E : 13 / 15	12,740	4·68	596	Reg. Jersey
J. Burnett ..	Beeac	Baby ..	BK : 34 / 13	12,078	4·92	594	Reg. Jersey
H. Graham ..	Traralgon ..	Treasure ..	E : 79 / 12	13,378	4·39	587	Reg. Jersey
G. Clyne	Maffra ..	Puff	V : 2 / 85	11,571	5·01	583	Reg. Jersey
G. Clyne ..	Maffra ..	Gracefull ..	V : 2 / 102	11,804	4·9	583	Reg. Jersey
J. McLeod ..	Bunyip ..	Cherry ..	P : 3 / 2	12,754	4·44	577	Jersey
A. Robinson	Rochester	Bluey ..	R : 42 / 6	15,523	3·69	573	Grade Ayrshire
F. Webster ..	Maffra ..	Eilleen ..	V : 3 / 26	10,402	5·4	572	Reg. Jersey
R. Rautman ..	Maffra ..	Creamey ..	V : 14 / 12	9,767	5·8	569	Grade Jersey
J. Clyne ..	Maffra No. 2 ..	Janet ..	AV : 36 / 75	11,332	5·0	569	Reg. Jersey

NOTE.—Sometimes unregistered bulls are termed "grades." Where bulls are registered they are reported as sueh. All the cows in this list were four years old or more at the beginning of the test, with the exception of "Silver Belle," a three-year old. Mr. Gannon's fine young cow "Ponsie" was only five years old. On two previous occasions her record exceeded 670 lb. butter-fat. After the 1933–34 test she was given a good spell and when she calved again she was yielding splendidly when suddenly she showed signs of sickness and died. A post-mortem examination revealed that the cause of death was coccidiosis.

Mr. F. E. Johnson's unregistered Jersey bull, "Barney." Twenty of his junior daughters averaged 359 lb. butter-fat. The average yield of their mature dams was 308 lb. only.

averaged 396 lb. "Cocky," with a six-year average of 543 lb. butter-fat, came very close to getting into the section for the "best twenty cows." Her record was 558 lb.; that of her half-sister "Jet" was 546 lb.

Mr. C. J. Pierce, of Rochester, owns a high producing herd; two of these exceeded 500 lb. of butter-fat.

Three of the herd of 21 of Mr. J. D. Pearce, of Rochester, exceeded 500 lb. This splendid herd had the second top average of the year with a record of 422 lb. per cow. It was closely followed by that of Mr. E. Swayn, of Stanhope Association, whose twenty cows averaged 416 lb.; four of them, including "Pansy," one of the best twenty producers of the year, averaged over 500 lb. Another man whose herd has been very prominent for some time past is Mr. O. Thaw. This year his 24 cows averaged 383 lb.; two of them topped the 500-lb. mark—one of these two was "Jewel," who was included in last year's "best twenty"; this year her yield was 529 lb.

Mr. J. MacClusky's herd of 21 was four less in number than in the previous year. Its record was 407 lb., 16 lb. a cow better than last year. Mr. T. Glover's record of 406 lb. average from 34 cows is a fine achievement, for Loch experienced a lean pasture year. Mr. Geo. Stanlake's herd is from the same area, his 377 lb. average was only 9 lb. less than that of the previous year, when one cow less was milked.

The herd of Mr. H. Prime, of Winchelsea, is well known in the district. It fell below the 400 lb. mark by 1 lb. per cow. To have

Calves belonging to Messrs. Walker Bros. of Yinnar are fed with a little crushed oats, chaff or hay, during the winter.

attained the position it did in such select company from the whole of the State is a distinction.

Messrs. R. and A. McClelland, of Geelong, are well-known horse-breeders. The average of 393 lb. butter-fat for 24 cows shows their ability as dairy farmers. Mr. J. G. Howell's fine herd was again prominent. It consisted of 34 cows, whose average was 378 lb. butter-fat; four of them yielded over 500 lb. each.

TABLE X.—GIPPSLAND AREA.

Unit of Association.	Association Registered Brand.	No. of Herds.	No. of Cows.	Average Yield of Butter-fat.	Percentage of Junior Cows in Association.	No. of Pure-bred Bulls.
Maffra No. 1	V	24	1,046	291·5	47	24
Toora	W	27	888	254·9	34	26
Dumbalk North	D	25	951	254·5	40	19
Dumbalk	S	17	841	253·8	43	13
Narracan No. 3	NB	29	643	252·8	54	21
Leongatha No. 4	JV	19	482	252·6	49	9
Maffra No. 2	AV	23	988	249·0	49	17
Yinnar No. 1	Y	29	907	246·7	49	16
Leongatha No. 1	L	19	552	245·4	44	10
Narracan No. 2	NA	28	531	243·7	44	20
Loch	K	18	504	236·5	60	12
Yinnar No. 3	Y	27	777	237·0	51	22
Sale	O	24	519	235·6	30	17
Maffra No. 5	O	29	1,125	234·0	56	26
Jindivick–Neerim No. 2	A	25	531	234·0	46	14
Warragul No. 2	G	27	612	233·5	49	17
Bunyip	B	25	567	233·2	55	20
Yarram No. 1	V	14	609	232·3	41	14
Pakenham	P	28	718	231·9	53	20
Wonthaggi	A	23	596	231·7	51	20
Traralgon No. 1	E	20	675	228·4	49	15
Gainsborough	D	17	757	228·3	45	13
Mountain View	W	24	698	225·2	49	15
Lang Lang	B	23	636	225·1	51	25
Warragul No. 1	G	24	696	224·8	50	26
Peninsula	NP	24	344	224·4	51	19
Jindivick–Neerim No. 1	J	25	601	223·1	46	18
Traralgon No. 2	E	21	784	221·6	45	18
Maffra No. 4	VC	26	1,012	220·8	43	20
Stony Creek	S	25	646	218·0	46	25
Mirboo North No. 1	M	18	464	216·7	44	9
Kongwak	K	29	838	216·5	43	14
Mirboo North No. 2	M	21	509	214·3	74	10
Korumburra No. 1	K	27	987	213·4	57	19
Fish Creek	S	26	640	213·2	43	12
Bairnsdale	CB	12	336	213·1	54	12
Korumburra No. 2	HB	27	843	211·4	50	26
Poowong No. 2	AP	19	625	211·4	52	17
Leongatha No. 2	A	20	666	209·3	54	6
Warragul No. 3	G	27	756	206·1	45	18
Foster	R	23	586	204·6	57	20
Maffra No. 6	VE	21	876	203·0	53	14
Orbost	O	10	349	202·5	37	10
Maffra No. 3	V	20	795	201·9	48	15
Yarram No. 2	VA	23	801	199·2	47	26
Boolarra No. 2	B	14	550	193·8	67	14
Leongatha No. 3	L	21	563	192·6	45	10
Cann River	R	9	376	188·9	42	5
Tarwin Lower	T	25	1,502	185·8	27	24
Yinnar No. 2	A	16	384	176·5	39	8
Poowong No. 1	P	16	663	173·9	68	11
Boolarra No. 1	B	22	531	169·1	39	13
Totals	..	1,155	35,007	..	47	854

Four daughters of "Welcome Nugget of Aberdour" who over the last four years have yielded an average of 494 lb. of butter-fat. They are members of Mr. O. Thaw's herd.

Reference to the annual reports of previous years will give the names of Mesrs. J. Bennett, T. M. Noble, A. J. Evans, J. H. Whiston, and W. Swarbrick. The consistent producing of the herds of these men indicates what can be done by efficient dairy farmers with good animals.

Mr. H. Sharples, of Jindivick-Neerim, made a fine showing with his 27 cows and 387 lb. butter-fat.

Dairymen in parts of Australia can study the figures in Table III. with advantage, for they are records of large herds with fine performances. Mr. J. Clyne's herd fell back somewhat below their usually high level. Six cows exceeded the 500-lb. mark, including "Puff" and "Gracefull," who are included in the best twenty. Mr. Bjorksten's herd of 41 with 376 lb. butter-fat holds pride of place for herds of over 40; while Messrs. Kelleher Bros.' splendid herd of 67 cows averaged only 5 lb. less. Both are outstanding performances. Messrs. H. Furphy and J. Trease, of Dumbalk Association, each obtained good returns, although the season in that area was unusually bad. A reference to Table III. will show that eleven of the herds were tested in associations that enjoyed an unusually late summer and good autumn rains.

Mesrs. W. W. Smith, R. Buchanan, R. Turnbull, D. Nichols, and P. Nichols, of Tallangatta, and Mr. C. Tobin, of Eskdale, each have unusually fine large herds—in some cases much larger than the figures indicate—for only those cows that complete their records prior to 30th June appear in the year's summary.

Mr. J. Stockdale, of Traralgon, and the members of the Maffra Associations, all enjoyed better than average seasonal conditions. This good fortune, however, does not detract from the merit of their fine performances.

Mr. W. Mahoney, of Warrnambool, is the owner of a herd prominent from year to year. This is also true of Messrs. J. H. Batten and Sons, members of the same association, whose herd last year averaged 358 lb.; this year their herd of 71 cows averaged 337 lb. butter-fat. This splendid herd, consisting of grade and pure-bred Jerseys, is widely known throughout the western area.

In this section (herds between 60 and 80), members of the associations in the favoured rainfall area are again in prominence. The grade Jersey herds of Mrs. T. Cardwell and Mr. R. Cardwell have the excellent average of 327 lb. Mr. G. Nixon, C. Cross, T. Ley, and H. Andrews each own large herds with very good returns. Mr. J. A. Ford's herd of 65 has a high percentage of juniors; its average was 310 lb. All of these herds are machine milked. The performance of Mr. W. H. Hannon's grade herd of 61 cows shows what selected Ayrshires and good management can accomplish. As usual, Messrs. J. Moore and Company, of Yarram, are well to the fore in the extra large herd section.

Mr. O. Ussher's "Queen," which yielded 381 lb. butter-fat as a junior two-year-old.

Mr. J. Mitchell, of Swanpool, with a herd of 95, has the fine average of 289 lb.; Mr. J. Coohalan, of The Sisters Association, also scores well. Mr. Evans, of the newly-formed Gellibrand Association, has had excellent returns from a large herd.

TABLE XI.—WESTERN AREA.

Unit of Association.	Association Registered Brand.	No. of Herds.	No. of Cows.	Average Yield of Butter-fat.	Percentage of Junior Cows in Association.	No. of Pure-bred Bulls.
Winchelsea No. 1	HE	25	838	252·0	49	20
Gellibrand Valley	◇	26	977	243·6	36	18
Ballarat	AB	21	385	237·4	48	17
Talbot	M	12	250	237·1	44	11
Warrnambool	W	22	1,142	236·6	39	29
Geelong	H	26	513	231·8	54	22
Dreeite South	E	27	815	230·8	49	27
Cobden	C	24	916	228·4	34	..
Nalangil No. 2	N	18	915	225·0	43	15
Camperdown	F	19	787	224·8	47	15
Woodford	WF	16	909	223·7	37	22
Condah	G	27	792	218·1	43	27
Casterton	R	21	681	215·8	46	20
Macarthur	M	10	367	215·4	49	10
Newstead	NU	23	701	214·1	49	16
Nalangil No. 1	N	20	734	213·0	44	17
Kyneton	K	24	381	212·2	50	8
Portland	Q	20	493	212·0	47	10
The Sisters	S	24	913	211·7	45	22
Beeac	K	28	936	211·6	46	19
Apollo Bay	K	25	723	211·3	54	14
Noorat No. 2	T	19	875	210·1	45	15
Winchelsea No. 2	HD	27	657	207·0	52	14
Nalangil No. 3	N	25	781	207·0	44	19
Keayang	K	7	556	204·4	43	12
Bacchus Marsh	B	25	791	203·8	38	13
Noorat No. 1	I	20	960	202·6	48	22
South-Western	F	24	846	202·1	39	13
South Purrumbete	B	24	1,131	199·3	35	15
Ondit	Æ	26	906	198·8	42	19
Pomborneit	HB	18	876	198·1	43	14
Kolora	+	15	921	197·6	35	4
Port Campbell	C	26	1,008	195·2	53	2
Coleraine No. 2	C	19	709	193·2	44	16
South Glenelg	♡	16	234	190·9	43	2
Wurt Wurt Koort	W	13	1,038	189·8	28	22
Mortlake	F	23	796	189·8	43	12
Penshurst	R	15	539	189·7	60	28
Ecklin	K	24	1,005	188·7	51	22
Coleraine No. 3	X	14	807	180·6	31	24
Coleraine No. 1	AC	19	683	177·6	41	14
Merino	E	13	388	165·1	52	13
Totals	..	870	31,735	193·0	50	674

The Leading Cows.

To have had a place among the best twenty when, as happened this year, there were over 93,000 cows tested, is a worthy distinction, but to have secured second place one year, and first place the succeeding year, is surely the mark of a champion of champions. Such a cow is "Ponsie," owned by Mr. T. Gannon, of Maffra. She was purchased, along with several others, as a yearling, and nothing is known of her ancestry.

The cow that won second place this year is "Lucy," owned by Mr. C. Robinson, of Rochester. She is by a grade Ayrshire bull. Her average yearly yield of 14,903 lb. milk and 644.5 lb. butter-fat during the past two years stamp her as a very fine producer. In each year's Grade Herd Test, she has been one of the first twenty. "Bluey," another of this year's first twenty, is also owned by Mr. Robinson.

Another very fine cow is Mr. P. Rantman's "Creamy." Her yields of 618 lb. for last year, and 568 lb. for the previous year, following on other good records, are an indication of excellent dairy qualities.

There are few finer producers in the State than Mr. G. Clyne's young cow "Gracefull." Her yield as a three-year-old in 1932-33 was 583 lb., and last year her record was 651 lb. "Puff," a herd-mate, produced 583 lb. butter-fat last year. Both cows were sired by registered bulls.

An interesting cow is "Eilleen," owned by Mr. F. Webster, of the Maffra Association. She is a half-sister to Australia's champion grade cow "Julia," whose three-year average of 800 lb. butter-fat will probably remain unbeaten for many years. In 1931, the average yield of seven half sisters, of whom "Eilleen" was one, was 600 lb.; for that year her record was 743 lb. In the year just passed her return was 572 lb. The sire of this cow was bred at "Jerseyholm," one of the first stud farms to be entered in the Standard Herd Test.

Two of the fine herd of Mr. D. Turnbull, of Tallangatta, are amongst the first twenty. One produced 615 lb. butter-fat, the other 567 lb.; a third member with 566 lb., just missed a place.

"Cocky," owned by Mr. G. Beasley, is one of a splendid family by an unregistered Jersey bull. They are not noted for beauty, but for their deep roomy frames and their remarkably consistent production. The sire has had an extraordinary influence on Mr. Beasley's herd. During seven years, "Cocky's" average was 545 lb.; on two occasions it was over 600 lb.

A well-made stack of meadow hay.

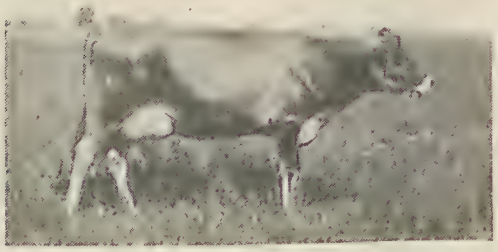
Mr. N. J. Reid's "Lu Lu" has been a very consistent producer in the Gainsborough Association for several years. On one occasion her record exceeded 700 lb.; her last record was over 500 lb. Two members of the herd of Mr. C. J. Pierce, of Rochester, yielded over 500 lb.

TABLE XII.—GOULBURN VALLEY AREA.

Unit of Association.	Association Registered Brand.	No. of Herds.	No. of Cows.	Average Yield of Butter-fat.	Percentage of Junior Cows in Association.	No. of Pure-bred Bulls.
Rochester No. 1	R	21	499	299·5	59	11
Swan Hill	S	27	573	286·6	66	33
Werribee South	V	21	708	277·6	47	18
Rochester No. 2	R	24	572	274·0	61	13
Stanhope No. 1	S	26	596	271·7	61	24
Tongala No. 1	T	26	834	270·7	51	26
North Murchison	NR	27	649	269·3	59	25
Leitchville No. 1	AH	25	898	264·6	48	28
Cohuna No. 2	HG	14	379	258·8	63	10
Katandra West	T	25	502	257·7	58	11
Cohuna No. 1	G	22	787	248·6	53	15
Kerang No. 2	H	21	609	245·5	58	18
Stanhope No. 2	S	24	602	241·8	60	19
North Shepparton	F	21	385	232·9	49	19
Undera	U	30	626	232·0	50	15
Pyramid Hill	Δ	27	682	222·1	47	15
Koroop	K	27	727	220·8	54	11
Leitchville No. 2	A	20	720	219·7	52	17
Leitchville No. 3	A	26	933	218·4	54	19
Murrabit	M	23	405	213·0	51	18
Kerang No. 1	H	23	742	204·7	68	21
Calivil	±	24	560	178·7	63	6
Totals	..	524	13,988	244·0	55	392

TABLE XIII.—NORTH-EAST AREA.

Unit of Association.	Association Registered Brand.	No. of Herds.	No. of Cows.	Average Yield of Butter-fat.	Percentage of Junior Cows in Association.	No. of Pure-bred Bulls.
Eskdale No. 1	E	20	906	271·6	33	20
Myrtleford No. 1	Z	14	413	262·5	45	13
Eskdale No. 2	E	19	625	253·5	39	10
Tallangatta No. 1	T	24	872	252·6	45	19
Myrtleford No. 3	Z	15	432	238·6	48	9
Kiewa Valley No. 2	K	22	1,101	237·5	38	22
Swanpool No. 2	D	20	464	233·2	51	17
Upper Murray No. 2	U	23	821	229·0	37	24
Moyhu	K	19	526	222·6	51	15
Tallangatta No. 2	I	24	828	215·5	55	15
Swanpool No. 1	D	22	613	214·1	43	27
Kiewa Valley No. 1	K	16	528	211·0	48	12
Millewa No. 1	X	24	668	208·0	46	13
Millewa No. 2	X	23	910	202·0	48	10
Euroa	S	24	572	199·5	44	17
Walwa	E	13	427	197·0	48	13
Upper Murray No. 1	U	19	888	196·8	37	23
Alexandra	A	20	629	190·6	51	15
Seymour	MK	Annual report not available				
Totals		361	12,223	225·5	44	294



Mr. O. Ussher's "Tobacco," which yielded 391 lb. butter-fat as a junior two-year-old.

For young cows, Messrs. Warner and McKenzie, of the Toora-Welshpool Association, hold pride of place with "Silver Belle," a registered three-year-old Jersey. Her record of 617 lb. placed her eighth among the best twenty cows.

Mr. E. Neave, of the Traralgon Association, has a promising junior in "Annie," by a registered Jersey. Her yield last year was 523 lb. butter-fat. One has to know the steep hill country of Callignee to appreciate this record, as well as that of another member of the herd which, with 564 lb., just missed being one of the first twenty.

It must not be overlooked that a cow who, in one year, takes a place amongst the first twenty, may not be the equal of an animal that averages 400 lb. butter-fat over a period of several years. One animal may be on a farm in a good rainfall area, and be treated exactly as a dairy cow should, and therefore yield better than one lacking all the advantages. A cow's worth, however, is usually revealed by comparing her record with the average of the district.

Herd Test Branding Scheme.

Early in the history of herd-testing, there was shown to be a need for a distinguishing brand. It was evident that the running number in a herd or an association was insuffi-

Mr. H. Furphy's "Lorna," top cow of the Dumbalk Association for the past three years.

[*Continued on page* 190.

Stem Rust at Werribee*

Its Incidence During 1934

By A. J. Vasey, B.Agr.Sc.; J. G. Baldwin, B.Agr.Sc.; and A. C. Doery, B.Agr.Sc.

THE occurrence of stem rust (*Puccinia graminis tritici*) throughout the wheat-growing districts of Victoria and the Riverina during the past season, has been most irregular. It is the object of this article to record the damage done, by stem rust, to the wheat crop at the State Research Farm, Werribee, during 1934, and to compare the incidence of the disease with the climatic factors experienced and the variable plant growth occurring in the different experimental plots at this centre, where for many years accurate records of meteorological and cropping data have been kept.

Since 1926, it has been the practice at the Research Farm to use the crop census method of Engledow (1) for the observation of the growing crop in the field, and by the analysis of the final yield, to evaluate the contributions of the various yield factors. The measurements obtained by this method in 1934 form the basis of this article, and the damage indicated therein is compared with the determinations of the eight previous and rustless years.

Only twice in the last twenty years, 1916 and 1934, have attacks of stem rust at Werribee been of economic importance. The unusual meteorological conditions which were responsible for the outbreak in 1934 are shown in Fig. 1.

The rainfall for the months of October and November was 8·33 inches, or 227 per cent. above the average for this period. The relative humidity readings for the late spring of 1934 are in consequence considerably higher than usual, though much of the rainfall was associated with strong south-westerly winds, and therefore temperatures tended to be lower. During the first week of November only was a period of high humidity experienced together with relatively high maximum temperatures, and the observations indicate that the main attack of stem rust took place at this time. The actual time of this critical period in relation to the flowering date of the crop being studied should be noted.

The harvest data from the eight previous crops of Free Gallipoli sown on fallow at Werribee at the rate of 12 grains per foot and 1½ cwt. of superphosphate per acre, are summarized in Table I. It will be seen that the figures for crop density—ears per foot of drill row—vary between the limits of 17·0 and 9·64 over the period 1926 to 1933, with a mean of 12·6. The 1934 crop was therefore thicker than usual. With regard to the factor of yield per ear, the readings vary from ·931 gm. to ·581 gm., with a mean of ·755 gm. In this comparison the figure for 1934 is definitely disappointing. Carrying the analysis further, it will be seen that the determination for the number of grains per ear—"n"—shows no abnormality, the weakness being confined to the weight of grain, which, as a result of the rust attack, at 32·5 gm. per 1,000 grains, is the lowest yet recorded at Werribee.

TABLE 1.—GIVING THE YIELD ANALYSIS OF NINE CROPS OF FREE GALLIPOLI WHEAT AT WERRIBEE, 1926–1934.

Season.	Average Number of Ears per Foot.	Average Yield per Ear.	Average Number of Grains per Ear.	Average Weight per 1,000 Grains.	Yield per Acre.
		gm.		gm.	bush.
1926 ..	11·9	·84	..	..	27·5
1927 ..	12·8	·66	15·9	42·0	22·4
1928 ..	12·2	·581	13·7	42·0	19·2
1929 ..	14·4	·75	20·0	37·5	29·8
1930 ..	12·6	·67	20·2	33·1	22·7
1931 ..	9·64	·87	19·0	45·8	23·0
1932 ..	17·0	·74	17·9	41·2	28·2
1933 ..	10·4	·931	19·6	47·5	26·6
Mean (1926-33)	**12·6**	**·755**	**18·0**	**41·3**	**24·9**
1934 ..	15·0	·616	19·6	32·5	25·4

N.B.—As a general rule all these crops were sown in May at the rate of 12 grains of seed per foot with superphosphate at the rate of 1½ cwt. per acre.

Estimates of Damage.

The final yield of the 1934 crop was 25·4 bushels per acre. Had the average size of ear, 0·755 gm., been attained a crop of this density would have yielded 31·2 bushels per acre. But, it is submitted, with the adequate rainfall experienced

* Paper read before Section K (Agriculture and Forestry) of the Australian and New Zealand Association for the Advancement of Science, Melbourne, 1935.

in the late spring of 1934, and in the absence of rust, a yield per ear equal to that of 1933—the highest previously obtained—might have been reasonably expected. Comparison between the number of grains per ear for these two years emphasizes such a probability. Had the 1933 weight of grain been realized, therefore, giving a yield per ear of ·931 gm., the yield per acre of this crop would have been 38·4 bushels per acre. It is suggested therefore that the loss in yield from this crop of Free Gallipoli wheat at Werribee due to rust attack was at least 13 bushels per acre. There was a further reduction in yield in other varieties where the flowering date more nearly approached the period indicated as optimum for rust attack. In these, the effect was not confined to the weight of grain, "g," but was observed also in a reduction of "n," the number of grains per ear.

Even with the variety Free Gallipoli, wherever environmental conditions induced lateness, so was the loss due to the rust increased. This fact had important repercussions in certain of the standard routine experiments, notably the Rate of Seeding Tests and the Manurial Trials with varying rates of superphosphate. It is well known that where any experimental condition affects crop density, a similar variation in time of maturity is observed. Thus in the two tests mentioned above the thinner crops, resulting from a low seeding rate or the absence of superphosphate, are invariably the latest of the series. The increased severity of the rust attack on the crops resulting from these treatments was sufficient to disturb completely the normal relation of the experimental yields.

In Table 2 certain of the census observations from the Rate of Seeding Tests are presented. Rarely, at Werribee, do the differences in yield between the extreme rates in this test exceed 15 to 20 per cent. The census studies (3) have shown that the greater crop density on the heavier sown plots is largely balanced by the higher yield per ear in the thinner crops. This difference in ear size results chiefly from a progressive decrease in the reading for "n" in the direction light to heavy sowing, that for "g" remaining fairly constant. During 1934, however, highly significant increases of considerable magnitude

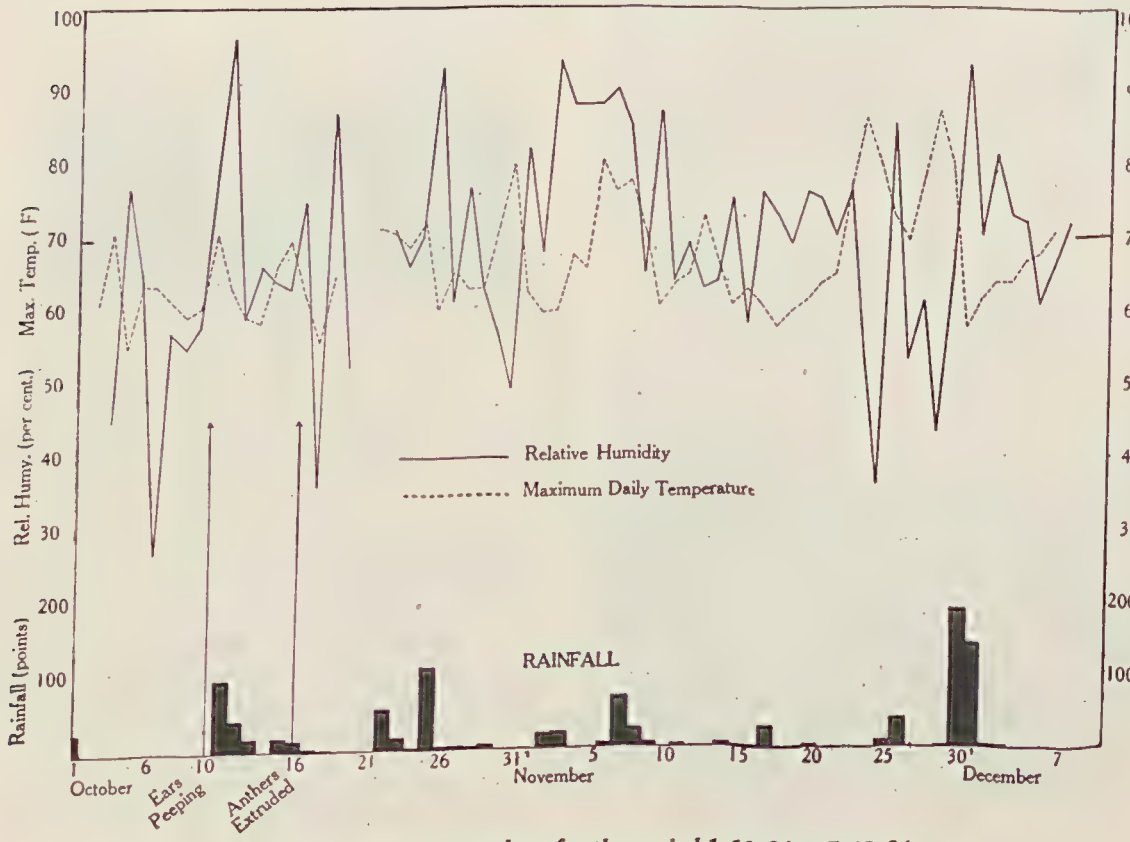


Fig. 1.—Werribee meteorology for the period 1.10.34 to 7.12.34.

were obtained up to a seeding of 16 grains per foot and the census explanation is as follows. While the recorded increase in crop density from light to heavy sowing may be regarded as normal, the increase in the severity of the rust attack in the opposite direction resulted in the denser crops also producing the greater yields per ear. On account of their relative earliness, consequent upon their density, they suffered no reduction in "n" and comparatively little in "g." For the lighter sown, and hence later crops, severe reductions were observed in both these yield factors. In this particular season, therefore, we have the paradox of the thickest crop producing the largest grain.

Such a series of results should not be included in the records of the Rate of Seeding Test, however, without suitable explanation for the depressed yields from the low rate of seeding.

TABLE 2.—GIVING CERTAIN OF THE CENSUS OBSERVATIONS ON THE CROPS IN THE RATE OF SEEDING TEST AT WERRIBEE, 1934, FREE GALLIPOLI.

Rate of Seeding. (Grains per foot.)	4.	8.	12.	16.	20.
Average number of ears per foot	100	144	161	182	180
Average yield per ear ..	100	110	113	123	120
Average number of grains per ear	100	96	96	95	94
Average weight per 1,000 grains	100	113	118	127	127
Average yield per acre ..	100	158	182	226	218

In each case the measurements are expressed as a percentage of that for the lowest rate, i.e., 4 grains per foot.

The Manurial Trial.

The efficiency of superphosphate as a manurial dressing for wheat in southern Australia has been long established. It has been shown by Richardson (4) and others, that the magnitude of the increases in yield obtained with successive increments of this fertilizer on good fallow, bear a direct relation to the increases in the number of ear-bearing tillers.

In the terms of the census investigation the increase is confined generally to crop density, yield per ear usually remaining constant. The curves therefore for percentage increase in yield and numbers of ears should normally coincide.

TABLE 3.—GIVING CERTAIN OF THE CENSUS OBSERVATIONS ON THE CROPS IN THE MANURIAL TEST AT WERRIBEE, 1934, FREE GALLIPOLI.

Rate of Superphosphate. (Cwt. per acre.)	0.	½.	1.	2.
Average number of ears per foot	100	124	147	160
Average yield per ear ..	100	132	130	123
Average number of grains per ear	100	113	110	106
Average weight per 1,000 grains	100	115	115	114
Average yield per acre ..	100	164	190	196

In each case the measurements are expressed as a percentage of that for the No Manure plot.

The effect of superphosphate in hastening maturity, apart from increasing crop density, has been observed from the early years of its introduction. Thus in the 1934 test, with rates ranging through ½ cwt. increments from 0 to 2 cwt. of superphosphate per acre, the "no manure" plots were considerably later than the remaining treatments, between which little difference in maturity could be distinguished. The effect of the stem rust on ear size, as indicated in Table 3, confirms this observation.

It will be seen from the census results presented here that the depressions in "n" and "g" in the case of the "no manure" treatment seriously disturbed the normal relation of its yield to that of the first ½ cwt. of superphosphate. The relations between the yields of the further increments are of more normal type. Again it is suggested that a careful explanation should accompany such a summary of results as that for the 1934 manurial trial.

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Tomato Leaf Mould

Recorded in Victoria

By S. Fish, M.Agr.Sc., Biologist, and A. T. Pugsley, B.Agr.Sc., Assistant Plant Pathologist

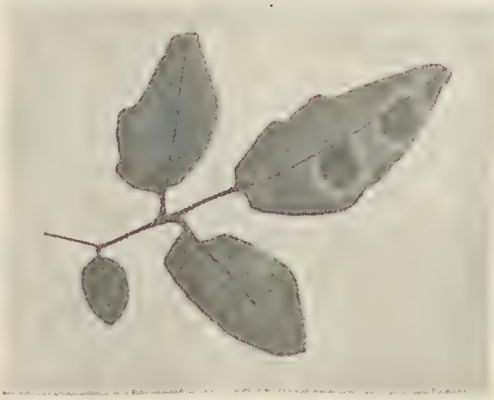
THE parasitic fungus *Cladosporium fulvum,* which causes the leaf-mould disease of tomatoes, was described from American material by Cooke(1) in 1883. It has now spread from country to country, becoming world-wide in its distribution. In England it is considered to be the most important leaf disease of the tomato as well as one of the most difficult to control. In most countries it is of economic significance in glasshouses only.

Although tomato leaf mould was recorded by Kirk (2) in New Zealand during 1897, it did not make its appearance in Australia until 1933, when it was reported from New South Wales by Magee (3). A note of the disease was made by Froggatt (4) in 1905, but there is no definite record of its presence in Australia at that time. Reference is made by McAlpine (5) in 1889 to a withering of tomato leaves by *Cladosporium solani* n.sp., but no further description is given.

The disease was first noticed in Victoria during the spring of 1934, when it appeared in three glasshouses situated in different areas of the State. In view of the heavy losses experienced by glasshouse growers of tomatoes in other countries, it is thought advisable to publish a description of the disease and to summarize the control measures recently adopted in England following upon the work of Small and others.

Symptoms of Tomato Leaf Mould.

These are based on observations made from naturally infected glasshouse tomatoes grown in Victoria. Since the most characteristic feature is a development of a mouldy, fungal growth on the leaves of the tomato plant, the name Tomato Leaf Mould has been given to this disease. Small white downy patches appear on the under sides of the leaves, and are accompanied by a yellowing of the tissue on the corresponding parts of the upper leaf surface. The colour of the fungal growth changes as the disease progresses. As the lesions enlarge the centre of each patch becomes pale buff, changing to a tawny-olive colour, and is surrounded by the advancing white margin. Usually there are several diseased patches on each leaf which may coalesce so that the entire under surface of the leaf is covered with a tawny-olive coloured mould. Such leaves are soon killed, and as they dry out the downy patches become purple coloured and the upper leaf surface changes from yellow to a reddish-brown when the leaf tissue is quite dead.



Leaf symptoms of Tomato Leaf Mould **(C. fulvum).**

Fructifications of the fungus have been observed on the young stems of the fruit, but in no instances have the main stems been attacked. Infection of both the calyx and ovary of the flowers has been noted, the calyx usually dying from the tip towards the base.

The general effect on the plant as a whole depends on several factors. In slight attacks the old leaves only are affected and comparatively little injury results. However, in severe cases the reduction of leaf area so weakens the plant that fruit production ceases and the plant dies prematurely.

Life Cycle

When one shakes a badly diseased plant, countless numbers of spores are dislodged from the under surface of the leaves. These rise to form a dustlike cloud, and are readily distributed to other plants in the glasshouse by air currents. Under suitable environmental conditions the spores falling on the leaves of tomato plants germinate, producing germ tubes which penetrate into the leaves by way of the stomatal openings. Overseas work has shown that the disease spreads most rapidly under conditions of dull light, humid atmosphere, and at temperatures between 20 and 25°C.

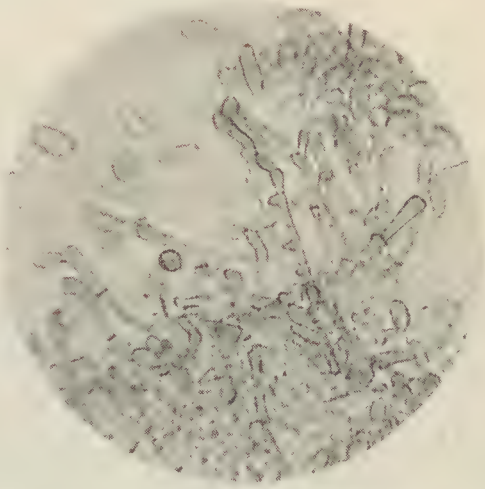
Having penetrated the host plant the fungus develops, reacting with the host to produce the symptoms already described. Spores are produced finally, and these are capable of reproducing the cycle. These conidial spores in a dry condition may remain viable for at least twelve months, so that they are able to live from season to season on walls and other structures of the glasshouse, and infect the plants of the following season's crop.

Control Measures.

1. *Adjustment of external factors rendering the plant less susceptible to attack.*— As a result of Small's (6) work on the relation of atmospheric temperature and humidity to tomato leaf mould, certain standard cultural methods have been set out which form the basis for control measures. The optimum temperature for the disease is about 72°F., lower temperatures being less favorable. It then follows that glasshouse temperatures should be kept as much below this temperature as possible.

Humidities exceeding 90 per cent. are very favorable, so that dry atmospheric conditions should be maintained continuously, and especially during warm weather, when temperatures are so conducive to the disease. Adequate house ventilation facilitates air movement, which in turn reduces both the temperature and the humidity. Free air movement about the plant is necessary, and can be obtained by a pruning of the lower leaves and by increasing the distance between the plants. This treatment would permit more light to reach the plant, which, in itself, plays a part in controlling the disease.

2. *Spraying.*—There is a great difference of opinion as to the value which sprays afford in protecting the plants from fungus invasion. Sulphur in its various forms is reported to be more effective than copper compounds.



Sporophores and conidia of C. fulvum, from natural leaf infection.

3. *Fumigation.* — Small's(7) experiments have shown that empty glasshouses may be satisfactorily disinfected and freed of viable *C. fulvum* spores by fumigation with sulphur dioxide, using sulphur at the rate of 10 lb. to 10,000 cubic feet of space.

Resistant varieties which would offer the best means of control are being developed abroad, but the work is still in the experimental state.

Identity of the Causal Organism.

A fungus corresponding with the description of *C. fulvum* has been isolated consistently from diseased leaves and sepals (Victorian material). The fungus has been cultivated on cultural media, used to reproduce the disease on experimental plants, and re-isolated. Conidiophores are produced from stromata on the underside of the leaf. These are mostly unbranched, septate, brown in colour, and produce conidia either from the apex or from the lateral nodular projections. The pale-brown conidia vary in size and shape, being oval to elliptical and approximately 20μ x 6μ. They usually are one to two celled.

The fungus grows well on potato dextrose agar, spreading evenly over the surface, sporulating freely, and forming an olive-coloured velvety growth. This organism is quite distinct from *Cladosporium herbarum*, a saprophytic mould which may develop on tomato leaves following damage by white fly.

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Grade Herd Testing

(*Continued from page* 184).

cient, for the number of one herd could not be distinguished from that of another in the same district.

A scheme of branding has been devised by the Victorian United Cow Testing Association, and all tested cows must bear a brand indicating their unit, the herd to which they belong, and their number in that unit. Every herd-tested cow, if properly branded, can be traced to the district and herd in which it was tested. For example, the brand on Mr. Gannon's "Ponsie" indicates that she was No. 3 cow in No. 2 herd of a unit of the Maffra Association. Or let us take the case of the tested animals in the herd of Mr. G. Clyne, of Maffra. "Puff" is No. 85, and "Gracefull" is No. 102 in No. 2 herd. The symbol V indicates the original unit of the Maffra Association.

Tables IX. to XIII. show the association registered brand, the numbers of herds and cows, average butter-fat production per cow, percentage of junior cows, and the number of pure-bred bulls in use in each unit.

The location of the brand has been for some years a contentious subject, as has been the question whether brands should be by tattoo or firebrand. On the right neck—the spot that has been chosen—may not be the best one, but that particular place was chosen as a low valued portion of the hide. If preferred, instead of on the right neck, the brand may be made on the right thigh. Registered cows need not be submitted to association fire-branding, provided there is sufficient identification otherwise.

The Victorian United Calf Testing Association's calf-marking scheme, which was recommended by the Dairy Experts Committee of the Conference of Ministers of Agriculture and Dairy Experts, held at Hobart in 1934, is based on the Grade Herd Testing scheme in operation in Victoria. It provides for a "dam and daughter" identification. Calves from accredited dams, whether grade or pure-bred, and by registered sires, whose dams have been certificated under the Government Standard Test, or approved by the Council of the Victorian United Calf Testing Association, are registered in this scheme. The scheme, which is entirely voluntary, has been very popular, no less than 68 units having adopted it. It is practically a registration on production. As compared with calves of unknown parentage, calves registered under this scheme are in many places keenly sought after. A certificate is issued for each marked calf, in which details of parentage and production are given, concerning which a declaration may be secured from both the owner and the tester.

CORRECTION.

In the first paragraph of the Standard Herd Records, published in the March issue of this *Journal*, it is stated that "251 cows qualified for the certificate." This should read "151 cows . . . .".

Pasture Top-dressing

The Use of Artificial Fertilizers

By W. D. Andrew, B.Agr.Sc., Assistant Agrostologist

PASTURE top-dressing has now become a regular practice on many farms in Victoria, and there are few farmers in dairying districts to-day, unfamiliar with the beneficial results that follow the judicious use of manure. Top-dressing on sound economic lines necessitates a study and a knowledge of the principles underlying the use of fertilizers, for while large increases in carrying capacity usually follow top-dressing, in a few cases, results have been disappointing. Plants require mineral matter for their growth and development, and the annual removal of large quantities of essential plant foods from the soil, such as calcium, phosphorus, potash, &c., as constituents of mutton, beef, milk, and hay which are sold off the farm, largely determines the type of pasture which persists.

Rank patches developing because of failure to spread animal droppings.

Where subjected to continuous grazing or cropping, land which naturally is deficient in one or more of these essential minerals declines in productivity, the better pasture plants, which are more exacting in their demands on fertility, disappear and the pasture becomes open and weedy.

Frequently the deterioration in the pasture indicates the nature of the treatment which such land should receive to maintain its stock-carrying capacity. It might be thought that the obvious method of determining which minerals should be supplied artificially would be a chemical analysis of the soil, but field trials with various manures have shown that definite recommendations cannot be made on soil analysis alone.

A certain amount of mineral matter removed by the grazing animal is returned to the soil in the animal excreta. Farmyard manure is a very rich fertilizer, and should be conserved and utilized to the fullest extent. Dung "pats" should be broken up and spread with the pasture harrows; otherwise, rank patches develop in the pasture, and are avoided by the stock and left ungrazed. These rank patches occupy space in the pasture which should be growing palatable food, and are not only wasteful, but encourage the entry of weeds into the pasture.

Phosphatic Fertilizers.

Except in a few cases, Victorian soils are deficient in phosphoric acid, and as there is a constant drain on the soil reserve of this material the first consideration in top-dressing is to correct this deficiency, and to do so in the cheapest and most convenient manner.

Several phosphatic manures are available for this purpose, and their efficacy depends mainly on their readily available, and not necessarily on the total, phosphoric acid content. For example, superphosphate contains 22 per cent. phosphoric acid, which is readily soluble, while ground rock phosphate has 36.5 per cent., but, as the latter is relatively insoluble, it is practically unavailable to the plant. For this reason rock phosphate gives poor results in comparison with superphosphate, although its total phosphorus content is higher.

The available phosphorus in basic phosphate is less than in superphosphate, but its price is

Left, top-dressed with superphosphate. Right, unmanured. Note high clover content in top-dressed section.

higher, so that considerably better results would have to be obtained to justify its use in preference to superphosphate.

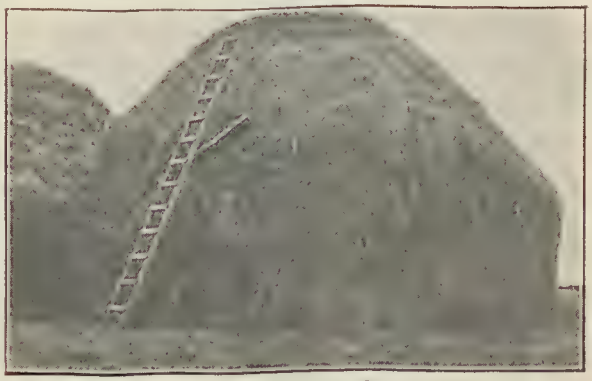
The most apparent result from phosphatic manure is the large increase in the proportion of clovers or legumes in the pasture. If the roots of a legume are examined closely, small fleshy nodules will be seen attached to them. These contain large numbers of nitrogen-fixing bacteria, which have the power of absorbing nitrogen and building it up into more complex compounds. When these nodules break up and the bacteria disintegrate, quantities of nitrogenous compounds are liberated, and these are readily absorbed by surrounding plants. Thus, the application of phosphate indirectly results in an increased supply of nitrogen to the pasture plants, and the increased growth of the grasses resulting from top-dressing with superphosphate is due to the nitrogen as well as to the phosphorus absorbed by the plants.

Pastures containing little or no clover usually do not show much response to phosphatic manures; this may explain why some pastures refuse to respond when soil analyses indicate a deficiency of phosphoric acid. In such cases, it is necesary to introduce a leguminous plant, a very satisfactory one for the purposes being subterranean clover. Objections are sometimes raised to the introduction of this plant because its strong growing habit enables it to dominate the sward for a few years after its establishment. Observations have shown, however, that the percentage of clover usually decreases after a few years, due to competition by the vigorous taller-growing grasses which have been stimulated by top-dressing, and a satisfactory balance is maintained. Occasionally there may be a season which suits subterranean clover particularly and causes it to become temporarily dominant.

In some cases superphosphate has failed to give much response, although there was a good percentage of clover in the pasture. On departmental plots at Stoneyford and Noorat where this has occurred, the high percentage of available phosphorous in the soil appears to be an explanation of the result. But these cases of high phosphatic fertility are rare, and generally a failure with superphosphate in the presence of clover can be traced either to the lack of other minerals, or physical, or biological infertility, which may be brought about by low temperatures, water-logging, or presence of toxic substances in the soil.

Besides the increase in growth which follows the application of phosphates, the quality of the pasture is materially improved, mainly because of the larger percentage of clover encouraged, which is rich in protein and mineral. Experiments have shown that the soluble ash content of the pasture may be doubled by using superphosphate, while one of the biggest increases is in the phosphorus content. This is important in cases where mineral deficiency diseases occur. The disease "cripples," which is due to a phosphorus deficiency, has been cured by top-dressing with superphosphate.

The effect of superphosphate on pasture growth is noticeable throughout the growing season, although it is most marked in the early spring, and the extent of its effect, to a large degree, is dependent on the season. Growth lasts longer into the winter and commences



Surplus feed as a result of top-dressing, stored for winter feed.

earlier in the spring, which means a longer growing period and additional growth, providing opportunities for collecting reserves for lean periods.

When superphosphate is mixed with the soil particles it becomes attached to various substances, and despite heavy or prolonged rains there is no fear of it being lost by leaching.

Superphosphate can be applied at almost any time of the year, but, to obtain full benefit, it is best applied early in the autumn, as soon as conditions of temperature and moisture become favorable for pasture growth.

Annual dressings are sometimes split up into autumn and spring applications, but it is doubtful whether this practice can be economically justified. At least 1 cwt. of superphosphate per acre per annum should be applied to dry pastures but, where good responses are known to occur, 2 cwt. appears to be the optimum amount to be used. There are several types of light manure spreaders on the market, and provided the implement spreads quickly, and with a reasonable degree of uniformity, it will be found quite suitable.

Nitrogenous Manures.

The application of nitrogenous manures, such as ammonium sulphate and sodium nitrate, has met with indifferent success. These fertilizers mainly encourage the growth of grasses, and these in turn tend to suppress the clovers, which are rich in protein and ash. The feeding value of the pasture is lowered, as an adequate amount of clover is essential to maintain the grasses in a vigorous productive condition.

If sulphate of ammonia is used in conjunction with an intensive rotational grazing system, under which the stock are feeding on the pasture always when it is short and rich in protein and ash, the alteration of nutritive value of the feed does not amount to much. Intensive rotational grazing has been adopted in a few places only in the non-irrigated districts of Victoria.

Tests with ammonium sulphate, over a number of years, have shown that it generally gives a sharp stimulus to pasture growth for a short time after application, but that following this, there is a long period of depression, and over the whole season it does not give payable returns. In trials carried out by the Department of Agriculture, the best results with sulphate of ammonia have been obtained on the red hill country of Gippsland. Here, early spring dressings together with superphosphate and lime have improved the pasture considerably.

Potash and Lime.

In a few cases potash has given a measurable response, e.g., at Cobrico and Larpent, in the Western District, but the high cost of this fertilizer necessitates large increases before its use can be economical. Where large quantities of potash are being removed, as a constituent of grass hay, occasional dressings of potash may become necessary to maintain production on some pasture soils.

Liming is a very old English practice, and early in the nineteenth century dressings of chalk up to 5 tons and more per acre were common. Marl was used for sandy and peaty soils to which it supplied both clay and lime. About the middle of that century the use of artificial manure largely displaced liming, although there is still a certain amount done at the present day.

Sorrel is supposed to be an indicator of lime deficiency, but field trials in some places have shown that applications of 1 ton of good quality lime on such land have had no effect on its productivity or on the amount of sorrel present.

During the last few years a good deal of propaganda in favour of lime has been circulated, but it should be fully realized that lime is not a substitute for superphosphate. Top-dressing trials in Victoria on a wide range of soil and pasture types have shown that lime together with superphosphate has given some response in a few cases only, but generally it gives no apparent result.

To summarize—

(1) Top-dressing is essential to maintain fertility.

(2) Superphosphate is outstanding as a fertilizer for this purpose.

(3) An attendant result from the use of phosphatic manures is the increase in legumes which supply nitrogen to the other pasture plants.

(4) Nitrogenous manures are costly and not recommended generally.

(5) Potassic fertilizers and lime are useful only in a few cases.

Nitrogenous Fertilizers

Use in Southern Victoria on Cereal Crops

RECENT experiments conducted by the Department of Agriculture indicate the possibilities of nitrogenous fertilizers used in conjunction with superphosphate for cereal crops grown on stubble land in Southern Victoria. For many years the Department has been carrying out experiments to ascertain the effects which various manures have on the growth of oat and barley crops.

In Southern Victoria, both superphosphate and nitrogenous manures and mixtures have been tested, and it has been shown that superphosphate is profitable to use under practically all seasonal and soil conditions. Crops there are grown sometimes on fallowed land, but often on stubble land following another cereal crop. The most economical quantity of superphosphate to apply varies with the district and the position of the crop in the rotation system practised, the amounts commonly used varying from ½ cwt. to 1½ cwt. per acre.

The heaviest crops are usually grown on fallowed land, and here it has been found that nitrogenous manures, such as sulphate of ammonia and nitrate of soda, are not required, the reason being that sufficient nitrates for use by the plants are formed in the soil while it is under fallow. On stubble land in Southern Victoria, where there is often a deficiency of nitrates, there is a greater call for the application of artificial nitrogenous manures, and more prospect for their profitable use.

To investigate the possibilities of economically increasing the yields of crops grown on stubble land in Southern Victoria, experiments were commenced in 1933 at the State Research Farm, Werribee, and in the Hamilton district on the farm of Mr. Geo. Kerr. Last year a further trial was instituted on the farm of Mr. H. Birkett at Windermere, near Ballarat, where it was desired to measure the effect of the manures on stubble land which had been heavily cropped for some years.

At Werribee, the tests were conducted on stubble land sown in the previous year with cereal crops grown on fallow; at Strathkellar the trials were on oaten hay stubble following peas, and at Windermere four oat crops had been harvested from the site in the five years previous to the tests.

At each centre, various quantities of superphosphate used alone, and also superphosphate mixed with sulphate of ammonia, were sown with oats in a series of replicated plots, each series including four plots of each treatment. Fairly good crops for the seasonal and soil conditions were obtained at Werribee and Strathkellar, but at Windermere the yield was low compared with the district average, as was expected on land that had been cropped so heavily in recent years.

Results of the Trials.

The outstanding result of the trials to date has been that the nitrogenous manure, sulphate of ammonia, when mixed with superphosphate, has caused heavier crops of hay to be grown on stubble land than where superphosphate was used alone. As the tests have been conducted at these centres for two seasons only, the figures obtained cannot be regarded as conclusive evidence, but, for the information of those interested in the use of nitrogenous manures, the average results of the more important treatments are given below:—

AVERAGE RESULTS OF OATEN HAY TRIALS WITH NITROGENOUS MANURES (1932-1933).

Manure Applied per Acre.	Yield of Hay in Cwt. per Acre.			Cost of Manure per Acre (Approximate).
	Research Farm, Werribee (Average 2 Years).	Strathkellar (Average 2 Years).	Windermere (1 Year only).	
	Cwt.	Cwt.	Cwt.	s. d.
No manure	18·9	36·9	18·1	..
Super., 1 cwt.	20·6	41·6	24·7	4 0
Super., 1 cwt. + ammon. sulphate, ½ cwt. (1½ cwt. of 2 : 1 mixture) ..	26·4	46·3	28·0	11 2
Super., 1 cwt. + ammon. sulphate, 1 cwt. (2 cwt. of 1 : 1 mixture) ..	31·6	55·8	33·0	16 6

[*Continued on page* 198.

Arsenical Spray Injury of Pears

By C. E. Cole, B.Agr.Sc., Horticultural Research Officer

DURING the latter part of this season many cases of damage to pears have been reported to the Department of Agriculture. Serious losses, sometimes up to 75 per cent. of the crop, have occurred in certain orchards in the metropolitan area.

The varieties concerned include Winter Cole, Josephine, Packham, Keiffer, Howell and Black Achan grafted on seedling stocks, also Keiffer and Williams' root graft. The most severe injury was in Josephine on Williams' root graft—a combination giving very stunted trees.

The trouble is typical of recorded arsenical spray injury and takes the form of a black or dark-brown more or less sunken area of irregular shape; generally near the calyx end of the pear. At first this area is quite hard and may crack as the fruit enlarges; as the pear matures, however, the injury softens, and may develop into a rot. Although in some cases leaf injury was present, this was not an important feature.

Several brands of lead arsenate were concerned in the injury; but as far as can be ascertained, neither the quality of the lead arsenate nor the spray programme were at fault. In every case, the last lead spray was applied about the first week in February, which was followed by several days of humid weather and drizzling rain; after which a hot spell was experienced. It was during this hot period that the injury showed up, but the primary development of the injury probably took place while the fruit was kept continually moist by light rains, allowing the production of soluble arsenic.

The injury appears to occur generally on the fruit of trees growing in a poorly drained soil, and not making good growth. This is the only factor concerned in the injury which can be controlled; and, if the symptoms reappear in later years, the drainage of the soil should be examined.

Although the injury has been recorded in other years, this is the first occasion on which it has reached serious and general proportions.

Six varieties of pears showing typical and extreme cases of spray injury.

Assorted Preserves

Preparation in the Home

By Miss A Knight, Fruit Preserving Expert.

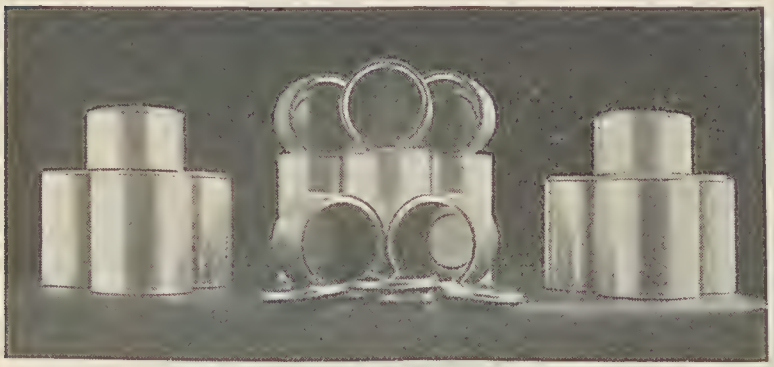
The preparation of various preserves is an interesting and profitable occupation for the average housewife, and it is at this time of year that a favourable opportunity presents itself for stocking the pantry with preserved fruits. These will be appreciated very much during the winter months, or in fact at any time during the year.

TOMATOES are plentiful at the present time, and when preserved they form the basis of many delicious preparations which usually are sought after in the home. It is of interest to know that lacquered tin cans are obtainable now at a very reasonable price. These fruit-preserving cans are made in various sizes, holding from 2 to 10 lb. of fruit, or larger if required, and they should prove very useful for preserving small or large quantities of tomatoes or other fruits. The inside of the can is well lacquered, and it is fitted with a firm press-in lid. The 2 or 2½ lb. tin would be suitable for preserving peeled tomatoes and tomato soup, while the larger sizes would be more satisfactory for conserving pulp intended for sauce, chutney, relish, &c.

A healthy tomato plant.

To can tomatoes, select firm ripe ones, and grade into even sizes. Remove the peel by immersing them in boiling water for two or three minutes, then cool quickly in cold water. This keeps the flesh firm, but loosens the skin, so that it can be peeled off easily. Cut away any hard core and stem, but be careful not to break the seed cells. The peeled tomatoes are then packed firmly into the cans, and a little well-seasoned tomato juice added, or if preferred, a good seasoning of salt and pepper and a trace of sugar may be put in instead of the extra juice. The lids are then pressed in and the cans placed in a sterilizer. They may be processed at a temperature of 180 deg. F. for one hour, or at boiling heat for half an hour. Remove the cans from the sterilizer, making sure that the lids are pressed well into position, and pour a little melted paraffin wax around the crevice of the lid.

To can tomato pulp which is used for making sauces and relishes, the simplest and quickest method is to wash them and cut away any defective parts, cut them up roughly, and put into a preserving pan, crushing them down a little to draw enough liquid to commence the cooking, and then bring to boiling heat. It is advantageous to keep a lid on the pan for a few minutes until the tomatoes soften down a little. Stir from the bottom of the pan occasionally



Lacquered tin cans suitable for fruit preserving.

to prevent burning. Allow the pulp to boil rapidly for fifteen or twenty minutes, when it will be ready to be ladled into the hot tins, which must be sealed air-tight immediately while very hot. They are then allowed to cool off and are stored for future use.

To prepare the sauce or relish, weigh the pulp, and to each pound of it allow the usual ingredients according to the favorite recipe. The pulp can be passed through a sieve either before adding the ingredients, or when the cooking is finished. When made, the tomato sauce should be poured into the bottles hot, but can be corked either hot or cold.

A tomato dressing that is nice when served with steak, boiled rice, lima beans, or sweet corn, is a very useful product to have preserved in the home. To make such a dressing, choose ripe tomatoes, and sufficient onion to flavour it nicely. Cut these up, and season the mixture well with salt, pepper, a little sugar, and if desired a trace of curry powder. Boil until very tender and well broken down, then pass the mixture through a sieve to remove skins and seeds. It should then be brought to boiling heat, poured into the hot cans and sealed air-tight while at a high temperature.

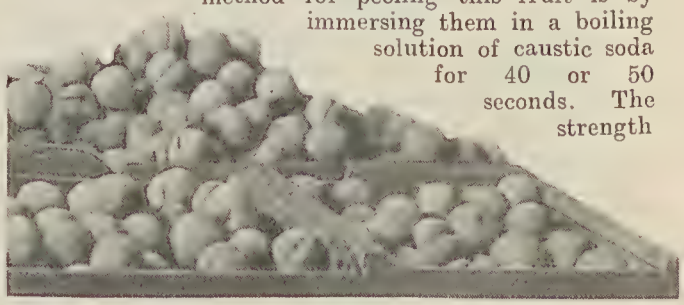
Preparing Apples.

Cooking apples are also plentiful just now, and these may be bottled or canned in large quantities, and held in readiness for making pies, blending with tomatoes for making chutney, or using in various other ways. They can be preserved with or without sugar. If intended to make into relishes, &c., it is better to preserve them unsweetened, but if they will be required for puddings or tarts, it is more convenient to sweeten the pulp before canning it. A slight flavouring of ginger, or cinnamon, or lemon juice, may be added. A variation which is likely to be appreciated is a combination of apple and quince. These fruits should be boiled together in a little sweet syrup until thoroughly cooked, then packed into cans while at boiling heat and sealed at once.

Canned baked apples also provide a change. Rather tart apples are best for this preparation. Grade them for size, wash and remove the core. Fill the cavity with sugar to which a litle cinnamon and butter has been added. Place them in a baking dish with a little water, and allow them to bake in a hot oven till they are tender. Then lift out carefully, pack them into the cans, and fill up with boiling syrup. One cup of sugar to one cup of water boiled together for five minutes will give a suitable syrup. Fit the lids on the tins, and heat them finally in the sterilizer for twenty minutes, after the water reaches boiling heat. Then remove the tins, and see that the lids are firmly in position, and pour a little melted wax round them. The 2½-lb. tins would be a very useful size for this. Preserved in this way, baked apples are excellent for serving with cream, custard, or short crust.

Peaches.

The yellow-fleshed clingstone, the Golden Queen, Phillips's Cling, Pullar's Cling, Goodman's Choice, &c., are good canning varieties which are now on the market. They can all be preserved in the home with little trouble, and are an excellent stand-by. They can be done whole, halved, or sliced. The most effective method for peeling this fruit is by immersing them in a boiling solution of caustic soda for 40 or 50 seconds. The strength



A good type of peach for canning.

of the solution should be about one tablespoonful of caustic soda to each quart of water. The container for this solution should not be a valuable one—a petrol tin cut down to a convenient size, and fitted with a handle, being quite suitable for the purpose. There should be enough caustic solution to cover the peaches entirely.

From the hot dip, they should be put into cold water at once or held under running water, and well washed. A vegetable brush will help to do this more thoroughly. The peaches are then packed into the tins, filled with syrup, which is made by boiling 4 or 6 oz. of sugar to each pint of water, then processed for about 45 minutes at boiling heat, or until the fruit is cooked, the time depending on the variety of peach, its stage of ripeness, the kind of pack, and also the size of the tin. When the fruit is cooked, push the lid well into place, and wax the top immediately.

Pears.

The William pears also make a nice preserve. They should be selected when firm ripe, then peeled, and cut in any desired way, or left whole.

The syrup to cover them in the cans may be either medium or strong, according to taste, but 4 or 6 oz. of sugar to each pint of water usually is preferred. This syrup should be made in advance and poured over the pears as soon as they are packed into the tins. Sterilize over boiling water for about 40 minutes, or until the fruit is cooked, and seal air-tight at once.

Figs.

Figs, too, are now ready for preserving, and they make a pleasing change from the other fruits. Care is needed in selecting the figs to make sure that they are absolutely fresh. The skins are removed by scalding the fruit in boiling water for a few minutes, when they can be gently wiped off. After peeling, and trimming the stem end neatly, put the figs into a strong syrup, which is prepared by using 12 oz. of sugar to each pint of water, a flavouring of ginger being added if desired. This should boil for ten minutes before adding the figs. Allow them to steep in this for twelve hours or so before cooking them. During the steeping, it is necessary to keep the fruit well under the syrup. After this period simmer gently, so that they do not break up for about ten minutes, and again leave them to steep over-night. Next day, pack them into the jars or cans, cover them with some of the syrup and process them for half an hour at boiling heat, then seal air-tight immediately.

Nitrogenous Fertilizers (*Continued from page* 194.)

The cost of the nitrogenous mixtures used is considerably more than that of superphosphate, but this cost was more than offset by the additional yields obtained.

Allowing the conservative price of £2 per ton for the hay, an additional 4 cwt. of hay per acre must be grown to warrant the use of 1½ cwt. per acre of the 2:1 mixture instead of 1 cwt. of super. alone, and an additional 7 cwt. of hay to justify the use of 2 cwt. per acre of the 1:1 mixture. In the experiments described, the use of the 1:1 mixture was the more profitable, and the increases obtained from 2 cwt. of this mixture over 1 cwt. of super. alone were 11 cwt. at Werribee, 14.2 cwt. at Strathkellar, and 8.3 cwt. at Windermere.

At Werribee similar results were obtained with oats harvested for grain, and with Pryor barley, the average results for two years being as shown in the accompanying table.

Valuing the oats at 2s. per bushel, and barley at 2s. 6d. per bushel, it will be seen that both nitrogenous mixtures increased the net returns very considerably.

Other trials with nitrogenous manures in Northern Victoria have failed to give such promising results, but it appears probable that, in Southern Victoria, where the average annual rainfall exceeds 19 inches, the yields of oat and barley crops grown on stubble land may be materially increased by the use of mixtures of superphosphate and sulphate of ammonia. It will be necessary, however, to conduct further experiments before definite recommendations can be given.

Manure per Acre.	Yield in Bushels per Acre.	
	Oats.	Barley.
	Bushels.	Bushels.
No manure	21·5	28·2
Super., 1 cwt.	23·2	30·2
Super. and ammon. sulphate, 1½ cwt. of 2:1 mixture	29·5	36·7
Super. and ammon. sulphate, 2 cwt. of 1:1 mixture	34·6	40·4

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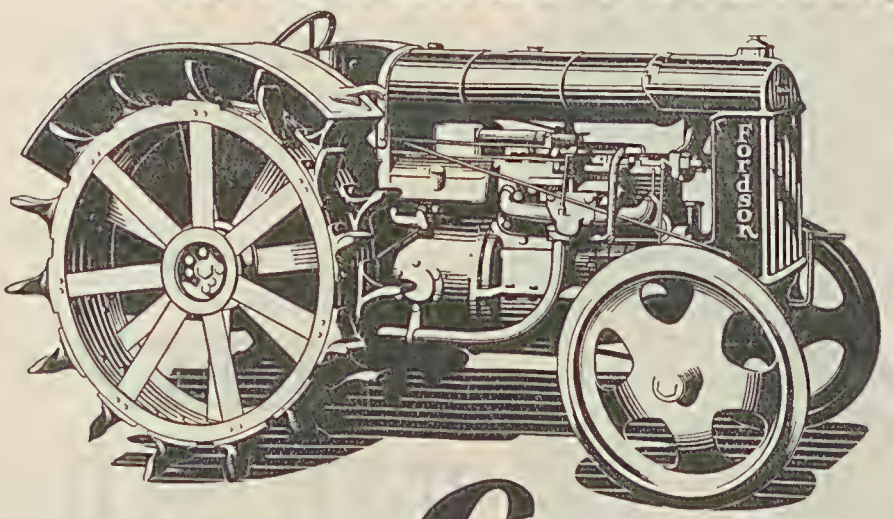

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Orchard and Garden Notes

By Edward E. Pescott, F.L.S.

Late Rose Tulips.

The Flower Garden.

ALL spring flowering bulbs should now be planted. For ordinary garden work we shall consider as bulbs such plants as daffodil (narcissus), tulip, hyacinth, freesia, heavenly blue, ranunculus, anemone, watsonia, and others.

All these send their roots downward from the base of the bulb; therefore, plant food should be placed belowed the bulbs. This can be done by turning in a supply of animal manure or a small quantity of bonedust when the soil is being dug over; the digging should be to the depth of the spade.

The bulbs should then be set in the soil; if possible, they should be bedded in sand. This especially applies to hyacinths, and also to any rare bulb.

Most bulbs should be planted with the tip from 4 to 5 inches below the surface; a light sandy soil is the best. Ranunculus, anemone, and freesias may be planted from 3 to 4 inches deep; watsonias about 3 inches.

Montbretias should also be planted out now. They flower in brown, yellow, and crimson-brown tones, and are increasing in popularity. They multiply freely, and are very useful for house decoration.

Give lime as a surface dressing to narcissus, tulip, and hyacinth, and avoid using it for anemone and ranunculus.

The Orchard.

As soon as all apples and pears are harvested, windfalls and waste fruit must be gathered and destroyed. On no account should fallen fruit be buried. Chemical codling bands may remain on the trees for the present, especially if autumn cultivation is intended; this disturbs any codling larvae in the soil, and they then enter the bandages. The bandages, however, should not be left on the trees through the winter, as the oil may injure the bark.

A record has been received from one orchard of a root-borer beetle entering the bandage and being killed. The Department is always anxious that any occurrence of this sort should be reported to it. In orchards where such diseases as peach or plum rust, peach, apricot, or cherry shot hole, or cherry aphis have been noticed, the tree leaves should be gathered as they fall and burnt.

For shot hole, the trees should be sprayed with Bordeaux mixture just as the final leaves are falling in autumn. A pink bud spraying should also be given in spring.

The Vegetable Garden.

Seedlings of all plants of the cabbage family should be planted out for late crops. Earlier plantings should be "hilled," and, if a spurt is necessary, given a dressing of sulphate of ammonia.

Seeds of all root crops should be sown for late harvesting. As seedlings grow, the rows should be thinned, and all weeds pulled when quite small.

Asparagus and rhubarb plots must be weeded and a good manurial top-dressing given. If the rhubarb crowns are old, they should be lifted, divided, and replanted.

Herb planting may still be carried out. Seeds and cuttings should be placed where the plants are to grow. Old plants may be cut back and given a dressing of manure. Lime is useful in the herb garden, but it must not be used in association with manure.

Professional Papers

[This section is devoted to professional papers and articles of a scientific character.]

The Absorption and Translocation of Herbicides

By A. Morgan, B.Agr.Sc., Weeds Research Officer, State Research Farm, Werribee, Victoria

A Paper read before Section M (Botany) of the Australian and New Zealand Association for the Advancement of Science, Melbourne, 1935

AMONG the weeds most difficult to eradicate at a reasonable expense are those perennials which have a root development and carbohydrate storage which appears to be out of all proportion to the extent of their top-growth. Notable examples are, "hoary cress" (*Lepidium Draba* L.) and "skeleton weed" (*Chondrilla juncea* L.).

To *seriously* damage plants of this type, it is obvious that the herbicide used must be capable of inflicting a maximum of injury to the root-system. Cultivation tests on hoary cress at Werribee (34) showed that, despite the prevention of any photosynthesis, 100 weekly cultivations were necessary to ensure the complete exhaustion of the carbohydrate reserves for all the plants in a patch. Similarly, in Idaho, it was found that "two seasons of thorough tillage followed by two years of check-rowed crops was the most economical and practical method for the eradication of large infestations" (of hoary cress) (48). In Utah (49) two seasons of fortnightly cultivation were found necessary to eradicate morning glory, Canada thistle, and perennial sow thistle. The futility of using a herbicide capable of killing only the top-growth is not always realized by those who find themselves faced with the task of controlling weeds of this type.

Three main chemical methods of attacking the root-system to a considerable depth are available, and it is convenient to classify them as follows:—(1) soil sterilization; (2) remote penetration of sprays; and (3) toxic gas production in the soil.

In the soil sterilization method, the herbicide is applied in solid or liquid form to the ground surface, preferably in contact with the crown of the plant, and permeates the upper soil, raising the content of the soil solution to a point above the limit of tolerance of the weed for that particular substance. To be efficient, this permeation of the soil must proceed to a depth just below that from which the plant can produce new shoots capable of reaching the the surface. This depth, which may be referred to as "critical," has been shown to be in the region of 2 feet in the case of hoary cress at Werribee (34), but in all probability it varies considerably with different weeds and with the soil type. According to Neller, the toxic effect of sodium chlorate on morning glory (*Convolvulus arvensis* L.) must be evident to a depth of 2 feet for thorough eradication (36).

Salt is used very successfully as a soil sterilizing agent, a notable example being the destruction of over 5,000,000 barberry bushes in the first few years of the Barberry Eradication Campaign in the United States of America. The important feature of this group of herbicides is that, to be efficient, their effect on the soil needs to be of sufficient duration to kill off a succession of generations of buds and root-hairs, and this persistence is then a serious drawback to crop production on treated areas.*

* According to Kramer (43) dead roots may readily absorb water, but in the case of a soil sterilizer the relative importance of the osmotic action of the external and of the absorbed herbicide has not been investigated.

The production of a temporary toxic concentration of gas in the soil air is thoroughly effective in weed eradication, provided the soil is sufficiently permeable to allow a satisfactory rate of diffusion of the gas, and provided the toxic concentration of gas exists throughout the soil air from the critical depth to the ground surface (26).

Carbon bisulphide has been proved most satisfactory in this group. There is no permanent harmful effect on the soil solution or micro-organisms (1, 2, 3). The concentration of gas in the soil air rapidly falls below the lethal level, and unless all roots to the critical depth are killed re-infestation soon takes place. In addition to the labour usually involved in introducing the herbicide into the soil, the cost of the material alone is nearly ten times the cost of eradication by cultivation, and for the reasons cited the use of a remote penetrant spray is preferable.

In the remote penetrant group are included those substances which, when sprayed on the foliage and stems of a weed, are absorbed into the vascular system and carried down into the roots to considerable depths. This action was first noted for a deep-rooted perennial weed by Gray (13) in 1917, although White-Haney (10) in 1915 had described the phenomenon for prickly pear. Provided there is uniform penetration down through the roots to the critical depth, and an excessive amount of spray material does not fall upon the ground, the plant is permanently eradicated without damage to the soil.

Successful treatments of this type are sufficiently frequent to inspire hope for the ultimate perfection of the method, particularly with arsenical compounds, with chlorates, and with ammonium thiocyanate (37). Failures, however, are numerous, and it is apparent that very careful attention to the factors governing the efficiency of such sprays is essential for consistently good results.

Despite the disadvantage of the dangerously poisonous character of the arsenical compounds, they have the great advantage that chemical methods for the detection and estimation of arsenic are so highly developed that these herbicides are particularly convenient for the study of the factors governing herbicide efficiency. It is logical to assume at present that, in some degree at least, the factors found to influence the remote penetration of arsenicals will be correspondingly important in regard to the chlorates.

A description of the technique employed in field and pot experiments with hoary cress at Werribee was published during 1931 (34, 35). Apart from the usual precautions for securing uniformity of material and method, and for obtaining pot plants in conditions approaching those found in the field, the main features were as follow:—

(*a*) The use of a method of sampling by means of which counts of the number of shoots killed by the spray could be made; and

(*b*) The adoption of "percentage shoot-kill still apparent at twelve months after treatment," as a basis of comparison of treatments, in order to avoid distortion of the results due to seasonal periodicity in regard to shoot-production, and to determine the relative permanency of control.

Confirmation of the validity of this method was obtained by tests on single plants. A similar statistical method was employed by Northcroft (22) in blackberry control experiments in New Zealand. It is necessary to bear in mind that, where only top growth is killed, apparent negative shoot-kills are obtained, due to the activity of buds near the crown of the plant.

Factors Governing Efficiency of Remote Penetrant Sprays.

The following remarks are in the form of a review, which includes work done at Werribee. The credit for a satisfactory theoretical explanation of remote penetration goes to Crafts and Kennedy (21, 30), who conducted extensive researches in California, into the control of *Convolvulus arvensis* L. by arsenical sprays.

A plant growing in moderately dry soil, and subject to heavy transpiration losses resulting from dry weather conditions, is losing water during the day at a greater rate than water is being absorbed through the root-hairs. Thus Thoday (6, 7) showed that a volume decrease of as much as 7 per cent. in ten minutes, may occur in transpiring leaves. According to Dixon (19) "abstraction of water by transpiration sets up tension in its (the xylem's) contents, while stability is conferred upon them by its subdivided structure. The introduction of a volume of liquid at the upper ends of the

tracheae (of a leaf), would produce a very considerable downward displacement in the comparatively narrow strands of tracheae supplying the leaf. Suitable measurements show that a 1 per cent. contraction of a leaf might lead to a downward movement in the petiole of 16 to 45 cm. in the leaves measured." (See also 9, 15.)

The important contribution made by Kennedy and Crafts has been to show the means whereby the action of the herbicide on the outer tissue is able to bring about the necessary "introduction of a volume of liquid," and the subsequent "considerable downward displacement." If an arsenical solution is sprayed on the plant, the first effect is that the tissues from the cuticle to the vessels are rapidly killed, and rendered permeable, so that the sap which they contain, mixed with some of the arsenical solution, passes into the xylem. Secondly, provided the degree of permeability produced is sufficient, the quantity of sap *plus* spray fluid entering the vessel is sufficient to counterbalance the water-deficit. In the process of equalization of pressure within the vessels the toxic fluid is rapidly forced down from the place of entry above-ground into the root-system. Later, lateral diffusion of the poison occurs, killing the storage tissue entered; this action is relatively slow. A similar penetration and movement within the vascular system have been described for petroleum oils by Ginsberg (38) and by Knight (27).

Provisionally accepting Craft's and Kennedy's theory, it is at once apparent that the essentials for success in the use of these sprays are—

(1) A good *retention* of herbicide on the plant surface.

(2) The use of a spray fluid capable of rapidly killing and rendering permeable the tissues from cuticle to xylem (which process may be termed *penetration*).

(3) The existence of a pronounced water-deficit within the xylem at the time of spraying, in order to obtain extensive downward movement of the herbicide in the xylem (which process may be termed *absorption*).

(4) A high *toxicity* of the herbicide, so that the small volume absorbed may be capable, in the extremely dilute solution, of destroying a large bulk of tissue when *lateral diffusion* takes place.

Retention on the Plant Surface.

Primarily, the leaf *plus* stem surface available for retention, must be as large as possible at the time of spraying. In the case of hoary cress, the young rosette stage usually is most unsatisfactory, for the reasons that the leaf surface is not optimum and that the rosette stage is produced, normally, at a period of the year when the transpiration rate usually is low.

Surface area increases rapidly with the growth of the rosette, and in a large one, may be in the region of 120 square inches (one side of the leaves only), but it is not until the flowering stalks are well developed that the weather conditions and soil moisture conditions are satisfactory (as will be shown later), i.e., from September onwards at Werribee. (See Table 1.) By that time most of the rosette leaves are dead, either from senility, or the attacks of the red-legged earth mite. Thus, surface area during the young flowering-stalk stage may be less than that during the late rosette stage. Later, as seed maturation proceeds, the larger lower leaves of the flowering stalk die off, again considerably reducing surface area. The effect of these changes on the retention of spray is shown in Table 2 (35).

Having a satisfactory area of leaf surface, the next step is to ensure that a maximum amount of spray will adhere to that surface in *liquid* form during the time necessary for complete penetration.

TABLE 1.—LEAF SURFACE OF HOARY CRESS ROSETTES.

(See photograph, p. 204.)

—	R.1.	R.2.	R.3.	R.4.	R.5.
Average number of leaves per rosette	6·3	7·8	8·7	13·7	13·1
Maximum number of leaves noted	8	10	11	20	22
Minimum number noted ..	5	6	7	9	9
Average leaf surface (one side only) in square inches ..	5	9	16	32	49
Range noted ..	3 to 8	6 to 16	9 to 25	17 to 51	19 to 122

These figures are based on results from 100 sets of measurements in each case.

TABLE 2.—RELATIVE AMOUNTS OF ARSENIC PENTOXIDE RETAINED ON HOARY CRESS SHOOTS OF VARYING GROWTH STAGE.

Description of Plant Shoot.	Mgm. Arsenic Pentoxide Retained (Mean of 10).
Small rosette	7·3
3 inches high, not yet flowering ..	11·6
3 inches high, flowers not opened ..	12·6
6 inches high, flowers not opened ..	16·3
6 inches high, seeding	14·0
9 inches high, seeding	14·8
12 inches high, seeding	14·2
15 inches high, seeding	13·5

NOTE.—Plot sprayed at rate of 125 gals. per acre with 6 per cent. solution.

A fine mist spray which deposits a large number of droplets, forming a film on the foliage, is obtained by using a pressure sprayer operating at about 100 lb. per square inch, and a nozzle of suitable design throwing a fan-shaped spray. White-Haney (10) found that with prickly pear, the destructive effects with atomizer spraying were more marked than with coarse spraying, for equivalent amounts of arsenic pentoxide. A *spreader* may be used, and for this purpose Sampson and Parker (32) noted that, in general, glue is most adaptable and economical for use with sodium chlorate; at Werribee a small quantity of molasses was added to arsenic pentoxide solution. Fish-oil soap occasionally is recommended for use with some proprietary arsenical weed-killers.

The quantity sprayed should not be enough to cause large drops to form and roll off to the ground. The optimum quantity varies considerably with the species, and with the luxuriance of growth and density of infestation; 100 gallons per acre is an average figure for hoary cress, while 500 gallons per acre is the amount usually required for morning glory.

Penetration to the Xylem.

For good results it is necessary that entry into the xylem be completed before the spray on the leaves has evaporated. This problem may be attacked in two ways:—(*a*) by the addition of a penetrating agent to the spray, and (*b*) by checking the rate of evaporation from the foliage.

PENETRATING AGENTS.

Strong acids, alkalies, and hydrocarbons function as penetrating agents, a fact which was appreciated in practice long before the actual mechanism of penetration was investigated. Thus, for prickly pear eradication, "Roberts's Improved Pear Poison," consisting of an approximately 20 per cent. arsenic pentoxide solution in moderately concentrated sulphuric acid, was recommended by the Prickly Pear Land Commission in 1927 (24). In some cases the effectiveness of a spray of acid reaction was ascribed to other qualities; thus White-Haney (10) concluded that it was the "extreme solubility of arsenic pentoxide in water on which success probably rests." Certainly its soluble character was an important factor, but, as pointed out by Crafts, only after penetration had occurred due to its acidity.

In comparison with the trioxide, arsenic pentoxide is expensive. Although the trioxide is cheap, its solubility in water is very low. Crafts (44) has overcome the difficulty by the use of a sodium arsenite solution acidified with sulphuric acid, and has determined the optimum concentrations of arsenic and acid for the control of morning glory in California. In 1930, Sampson and Parker (32) reported that the addition of sulphuric acid to sodium chlorate spray rendered the latter more efficient in the control of St. John's Wort, and its role in that connexion undoubtedly was to improve penetration, since it has been shown by Offord and d'Urbal (33) that plant protoplasm has a low coefficient of permeability with respect to sodium chlorate.

The mechanism of penetration has been studied by Aslander (25) and Crafts (45) with sulphuric acid, by Loomis *et al* (39) with sodium chlorate, and by White-Haney (8) with arsenic pentoxide. The similarity of the findings for these different chemicals emphasizes that the influence of the particular chemical used is on the *degree*, and not on the *mode*, of penetration. The theory that such substances enter the plant by way of the stomata is shown to be incorrect. Thus, Loomis showed that although 90 to 95 per cent. of the leaf stomata of *Fuchsia hybrida* Voss. are on the lower surface, a 10 per cent. sodium chlorate solution penetrated the upper surface as readily as the lower. Rudolph (19A) has shown that, in still air, one-third of the water-loss is through the cuticle. When a weed spray is applied to leaves, the particular toxic ions of the herbicide or of the penetrating agent diffuse through the cuticle, the main factors affecting the rate of diffusion being the thickness of the cuticle and the degree of waxiness or

Specimens of Hoary Cress in the "rosette" stage.

other features such as hairiness (Aslander, 25), which obstruct intimate contact of the herbicide and cuticle. Using mature leaves of the current season's growth of *Nerium Oleander* L., Loomis showed that penetration of the cuticle of the upper surface of the leaf by sodium chlorate solution was somewhat slower than through the lower surface, although the tissues were effectively killed in both cases. The cuticle on the upper surface of the leaves of this plant is unusually thick, and all the stomata occur in pits on the lower surface. With older leaves, penetration through the upper surface was very much reduced owing to the much thicker cuticle, while penetration was still good through the lower surface. Chemical tests indicated that the chlorate penetrated through the solid uninjured cuticle. Aslander (25) noted the penetration of sulphuric acid through the epidermal walls of a number of weed plants, but from the fact that there was early injury to the guard cells he reasoned that the stomata were the main points of entry, although injury occurred unassociated with the stomata. Crafts (45) has repeated Aslander's work on the penetration of leaves of *Elodea canadensis* by sulphuric acid, confirming the statement that the protoplasm is rapidly killed and rendered permeable without plasmolysis. The action is so rapid that apparently very little water is withdrawn. The results support the contention of Schultz (4) that death is due to chemical action, and not, as stated by Olive (5), to the osmotic properties of the solution. Crafts also gives data to show that the hydrogen ion concentration of the solution used is the important chemical factor in penetration by sulphuric acid.

The incorporation of sulphuric acid in a sodium arsenite solution secures rapid penetration, and the highly poisonous properties of the arsenite carried down through the vessels ensure that when lateral diffusion occurs, death of a large bulk of storage tissue is secured. According to the Californian experiments, a 0.5 per cent. solution of arsenic trioxide as sodium arsenite, to which sufficient sulphuric acid is added to make a 1.0N solution of the acid, is the arsenical spray most generally suitable for the control of *Convolvulus arvensis* L. The first trial of this spray on hoary cress at Werribee was made this year, but owing to the abnormally wet season experienced very poor results were obtained, so that it is not yet certain whether it is efficient in hoary cress control. However, it appears fairly certain that any variation of the Californian formula will be in regard to the acid-normality of the solution. Firstly, we have variation in the degree of cuticularization of various weed species, and in some the presence of hairs: Secondly, there is the buffering capacity of the

plant tissue penetrated—Crafts states that 12.5 cc. of decinormal hydrochloric acid was required to change the pH of 10 grams of ground morning glory foliage from 5.8 to 4.0—this capacity may vary.

Checking Evaporation from the Foliage.

Evaporation of spray from the leaves may be checked by spraying late in the day, when temperatures are lower, and by selecting calm weather. White-Haney (12) recommended spraying prickly pear during the hot bright part of the day in a *fairly moist* atmosphere, but this combination is not encountered sufficiently often in the southern States. Crafts (44) has found that a light spraying with water following the spraying proper gives good results, disposing of the necessity for evening application. An interesting application of the principle is the method advocated by Burns and Bhide (18), in which a film of oil is applied to lantana stumps previously swabbed with sodium arsenite solution. The hygroscopic property of sulphuric acid used to increase penetration may also tend to check evaporation.

Absorption.

The circumstances favouring a high absorption are sufficiently well known, viz., a high transpiration rate, and low soil moisture content. The main problem in regard to the practical application of this knowledge is the evolution of a satisfactory method of determination of the correct time to spray, i.e., of the evaluation of the composite effect of these conditions on the water-deficit of the plant. Reduction of these factors to a single simple and reliable test is essential. Is it sufficient to estimate the probable absorption of herbicide by a measurement of water-deficit, as obtained by cutting a stem under an aqueous solution of eosin and measuring the rate of travel of the coloured solution through the xylem? Tests made at Werribee during May to October, 1929, indicate that this method is not reliable, even when the test is well-replicated. From Table 3 it will be seen that just as good kills are obtained when the rate of absorption of eosin solution is low as when it is high, and vice versa. Further, out of thirteen plants tested in this manner on 10th September, a range of from 0 to 29 c.m. per minute was recorded, showing that the test would need to be applied to a considerable number of plants to obtain a reliable mean value.

Table 3.—Comparison of Spray Efficiency and Rate of Absorption of Eosin Solution at Time of Spraying.

Date.	Mean Eosin Absorption (cm. per min.).	Mean Percentage Shoot-kill still apparent after 12 months.
13.5.29	17·8	94·8
20.5.29	10·8	79·1
27.5.29	11·5	— 24·0
31.5.29	10·1	35·9
10.6.29	9·0	27·7
17.6.29	8·7	— 34·8
24.6.29	3·3	40·0
1.7.29	6·7	—104·0
8.7.29	4·6	44·2
15.7.29	7·2	55·6
22.7.29	..	..
29.7.29	..	— 6·1
12.8.29	..	65·4
20.8.29	12·1	— 13·0
26.8.29	25·8	44·2
3.9.29	..	51·7
10.9.29	16·3	13·7
17.9.29	..	66·1
24.9.29	10·3	27·8
3.10.29	12·7	87·0
14.10.29	..	— 5·5
22.10.29	21·3	78·5

Table 4.—Soil Moisture Determination on Hoary Cress Plots.

Date.	Mean Moisture Percentage (12 samples).				
	1st foot.	2nd foot.	3rd foot.	4th foot.	5th foot.
10.9.30	12·3	18·8	14·7	21·0	21·2
12.9.30	11·9	17·3	14·1	16·1	19·4
16.9.30	11·7	17·2	13·1	16·5	18·4
19.9.30	10·4	15·1	13·2	17·1	18·5
23.9.30	10·9	16·4	13·7	18·6	19·4
25.9.30	10·8	15·6	14·8	17·5	21·6
30.9.30	11·0	16·6	13·9	19·8	20·3
3.10.30	10·9	14·3	13·5	18·5	21·8
7.10.30	13·5	12·9	11·5	14·0	16·6
10.10.30	13·5	13·2	14·7	18·0	18·1
15.10.30	14·0	13·7	13·0	16·7	18·9
18.10.30	12·2	11·8	13·3	21·1	21·2
21.10.30	11·6	15·2	15·5	19·5	20·9
28.10.30	10·3	10·9	11·4	15·9	16·4
31.10.30	11·4	13·1	11·6	18·6	21·6
11.11.30	9·9	10·4	10·5	17·7	20·5
15.11.30	10·2	12·2	13·0	17·7	20·5
19.11.30	12·9	8·4	10·2	11·5	15·9
22.11.30	12·2	10·6	11·2	16·5	19·2

A test was made also of the value of soil moisture determination as a guide to probable absorption of arsenic pentoxide. Each week during September to November inclusive during 1930, soil samples were taken in foot sections to a depth of 5 feet in hoary cress plots, by means of a Veihmeyer soil tube. The samples were replicated twelve times, two borings being made on each of six plots, the whole test being in the randomized block arrangement. The plots were 1/500th acre. The foot samples were dried to constant weight at 93.3°C. in a Hearson electric incubator. The means of these determinations are given in Table 4. Owing to the type of rainfall distribution at Werribee, as illustrated in the accompanying graph (prepared in connexion with irrigated pasture tests), the soil moisture, calculated on the "dry at 93.3°C." basis, did not fall below

Table 5.—Depth of Absorption and Total Absorption of Arsenic Pentoxide by Hoary Cress Plants Grown in Pots.

Date Treated.	Absorption of Arsenic Pentoxide (Milligrams).				
	1st foot.	2nd foot.	3rd foot.	4th foot.	Total.
10.9.30 ..	1·73	0·13	0·03	0·02	1·91
17.9.30 ..	3·27	0·25	..	..	3·52
25.9.30 ..	2·12	0·30	..	..	2·42
2·10.30 ..	1·50	0·08	..	..	1·58
9.10.30 ..	0·77	0·47	0·05	0·05	1·34
16.10.30 ..	1·46	0·41	0·25	0·03	2·15
30.10.30 ..	2·12	4·60	6·40	0·31	13·43
6.11.30 ..	2·45	5·66	4·53	0·59	13·23

10 per cent. at any level. Table 5, which gives the results of pot experiments carried out at the same time, shows that the depth of absorption and total absorption of arsenic pentoxide by hoary cress plants reached a maximum when the moisture percentage of the

Table 6.—Showing Average Moisture Content of Soil at Selected Levels in Containers used in Single Plant Tests.

(Calculated on constant weight at 93.3°C.)

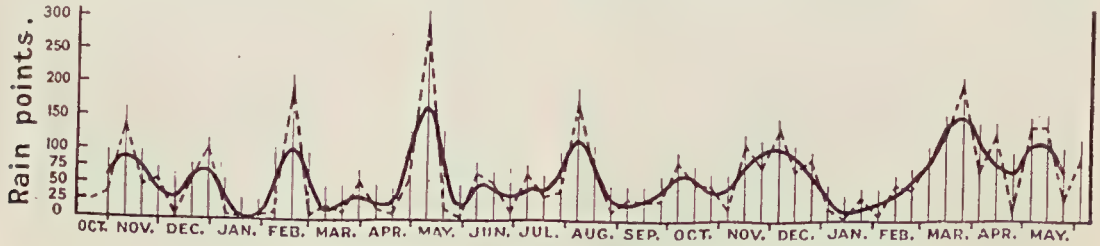
Date Sampled.	Average Moisture Content at Depths of—		
	12 inches.	30 inches.	48 inches.
10.9.30 ..	16·8	18·5	20·7
17.9.30 ..	13·1	15·3	22·2
25.9.30 ..	10·9	15·6	22·7
2.10.30 ..	8·9	11·9	18·1
9.10.30 ..	8·2	8·7	15·1
16.10.30 ..	10·6	10·0	15·7
30.10.30 ..	6·8	6·0	8·3
6.11.30 ..	5·2	5·3	6·4

deeper layers of the soil (Table 6), fell below 10 per cent., viz., 8 per cent. or less. Transpiration tests made concurrently, results of which are given in Table 7, showed that although transpiration was fairly high during late September and early October, depth of absorption, and total absorption of arsenic pentoxide were not outstanding. In late October and early November, the absorption was very good.

Table 7.—Showing Average Weekly Transpiration of Hoary Cress Plants.

Week Ending.	Transpiration in Pounds (Average of 4 plants).
10.9.30	1·3
17.9.30	4·9
24.9.30	5·4
1.10.30	5·9
8.10.30	3·3
15.10.30	1·7
22.10.30	3·6
29.10.30	4·2
5.11.30	8·8
12.11.30	9·1

Note.—Plants grown in pots described in "Water requirements of Farm Crops," A. E. V. Richardson, Victorian *Journal of Agriculture*, April to August, 1923.



Graph showing rainfall distribution—October, 1929, to May, 1931.

The inference is that a combination of high transpiration rate and particularly low soil moisture is necessary for best results, and that the measurement of any one of these factors, as a guide to the best time of spraying would be misleading in many instances.

The rainfall distribution in the South Wimmera, in which hoary cress has assumed major importance as a weed of wheat-growing land, is more conducive to the production of an extended period of low soil moisture conditions than at Werribee (47), consequently, tests were begun at Rupanyup. Later the extensive breakages in roots caused by cracking of the soil to a considerable depth, as drying progressed, caused the abandonment of the tests, as it was useless to spray plants which were occupying only the top foot or so of soil, while the disconnected roots below that level were already putting forth new shoots. To date, therefore, no more definite recommendation of the best time for treatment can be given than that of spraying in early summer after a period of hot dry weather.

Toxicity.

There appears to be no doubt as to the high toxicity of the cations of arsenical herbicides, which, without undergoing change in the plant cells during lateral diffusion, kill the storage tissue. Although from the evidence available it seems safe to assume that, in the case of the alkali chlorate sprays, the mode of penetration and absorption is similar to that of the arsenicals, the poisoning of the storage tissue during lateral diffusion is of a different character. The yellowish colour of the leaves of plants which recover partially from chlorate treatment suggests an interference with photosynthesis (23), while plants which recover from arsenical treatment do not show this.

It was pointed out during 1933, by Loomis and his associates (46) that the observations of Aslander (20), Schafer *et al* (29), and Loomis *et al*, viz., that chlorates may be used effectively while no topgrowth is present, suggest other effects beside translocation downward through the xylem, viz., absorption from the soil by roots and rhizomes. Arsenicals may be used successfully as soil sterilizing agents, but the action of the chlorates does not appear to be strictly of this type. That the effect of chlorate in the soil solution is *not* to kill the root hairs on contact, has been shown by Yamasaki's (40) investigations on the resistance of rice and other plants to potassium and sodium chlorates as correlated with drought and snow-rot resistance. Poisoning of solution culture seedlings by chlorate showed up microscopically as a brown colouring in the vascular bundles and adjacent tisue. The same symptoms occurred with sodium hypochlorite, but not with any other poisonous salt tested. The circumstance suggested that the poisonous ingredient was not the chlorate ion but the hypochlorite ion, well known as a plant poison. The relative harmlessness of chlorate to yeasts, and to some fungi and bacteria, was reported previously by Bokorny (14) and Aslander (28) respectively, and recently Bowser and Newton (41) reported that in soil it did not prevent nitrification and exerted only a slight depressing effect on the numbers of micro-organisms. By suitable tests Yamasaki determined that glucose and aldehydes, which usually occur in living plant cells (17), can reduce chlorates in acid solution. Further, among varieties of the plants tested, there was a correlation between the content of reducing substances and susceptibility to chlorate injury. Tests made with sodium hypochlorite applied to the soil as a weed eradicant have not been so successful as chlorate treatment, probably because the action of the former on roots is likely to be similar to that of a remote penetrant applied to foliage.

Other theories put forward to explain the action of chlorate, mention the possibility of the harmful effects of the production of nascent oxygen (Offord, cited by Johnson, 26) and the reduction of catalase activity of the roots (Neller, 36).

Another important difference between arsenicals and chlorate is in regard to the rate of fixation by the soil. According to Bowser and Newton, much of the sodium chlorate applied will remain undecomposed in moist soils under green-house conditions for at least eighteen months. Under field conditions in Alberta its toxicity lasted one year, but with 17 inches of rain from May to September, 1932, it was almost all leached out from the surface foot. Harper (31) and McGee and Lipscomb (32A) appear to be the only investigators reporting sodium chlorate to be rapidly decomposed in the soil. In Hawaii, McGeorge (11) found that the soil showed a strong fixing power for arsenic, especially when the organic content was high, and, when sodium arsenite is used,

the arsenic trioxide remains in the surface soil despite the leaching effect of rains and irrigation. Swingle (16) also reported that in Montana, six years after applications of arsenicals, practically all the arsenic still remained in the surface soil. With heavy sprayings of chlorate, therefore, absorption may first be obtained to some extent through the top-growth, and later, as the chlorate leaches down, through the roots, but with arsenicals the latter action is not pronounced. The yellowing of partially recovered plants may be attributed to a weak action of this sort. Naturally, absorption from the soil is a more reliable method than remote penetration of sprays, and this is reflected in the recommendations of recent workers, viz., quantities of sodium chlorate as high as 6 lb. per square rod, or alternatively a 1 lb. per square rod dosage followed by another of 4 or 5 lb., being specified for the eradication of hoary cress (48).

In conclusion, the influence of organic reserves at the time of spraying is worthy of mention, because of some confusion which exists as to the importance of this factor. Where cultivation or other mechanical means are employed in weed eradication it is of advantage to carry out such operations at a time when the chances of recovery of the plant are least. Where remote penetrants are employed, however, the reserves of the plant can be considered of secondary importance only, the primary aim being to select a time of treatment which promises well in regard to depth of absorption of the herbicide.

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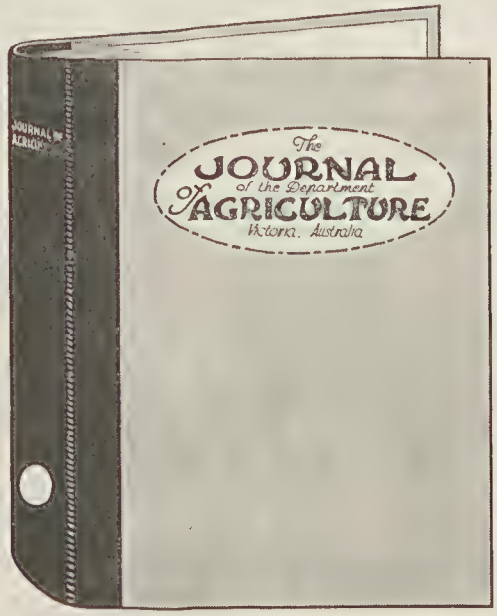

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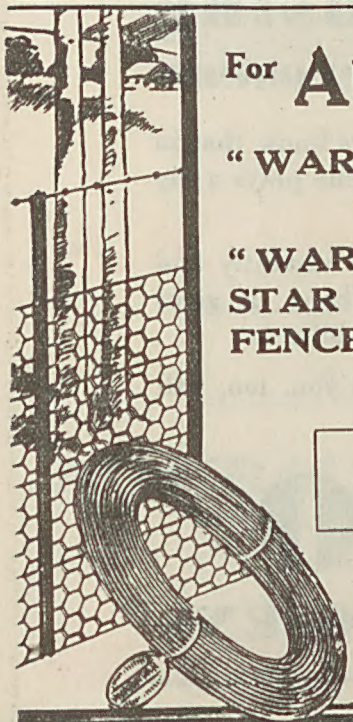

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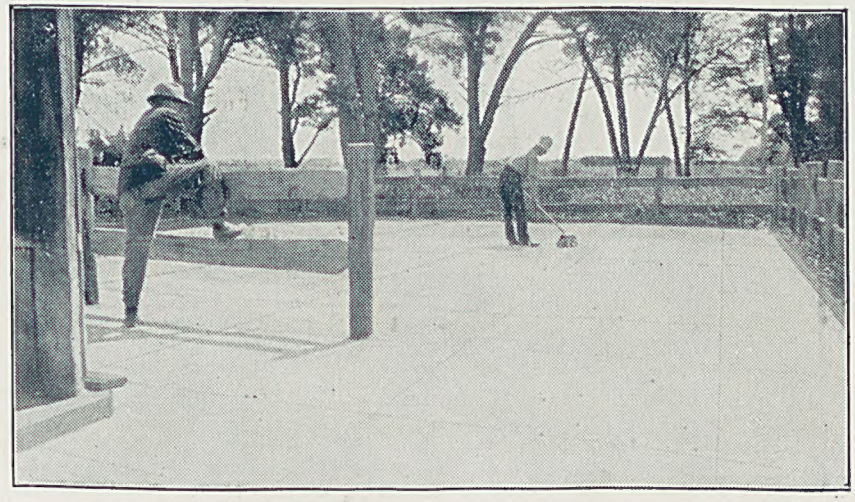

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¾ pint water ½ lb. prunes (soaked and stoned) ½ oz. gelatine
4 oz. sugar ¼ pint whipped cream ½ pint milk

Boil water and syrup for five minutes, add prunes, and simmer till tender. Lift prunes from syrup. Soak ½ oz. gelatine in ½ pint milk, and dissolve over slow fire, but do not let it get too hot. Add prune syrup to make ¾ pint. Stand till cold, and fold in ¼ pint whipped cream If no cream is available add ¼ pint more milk and the stiffly beaten whites of two eggs. Line a basin with prunes, and pour in the mixture, put in a cool place till set. Turn out, and serve with any prunes and syrup left over. To use up yolks of eggs, make a custard.

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